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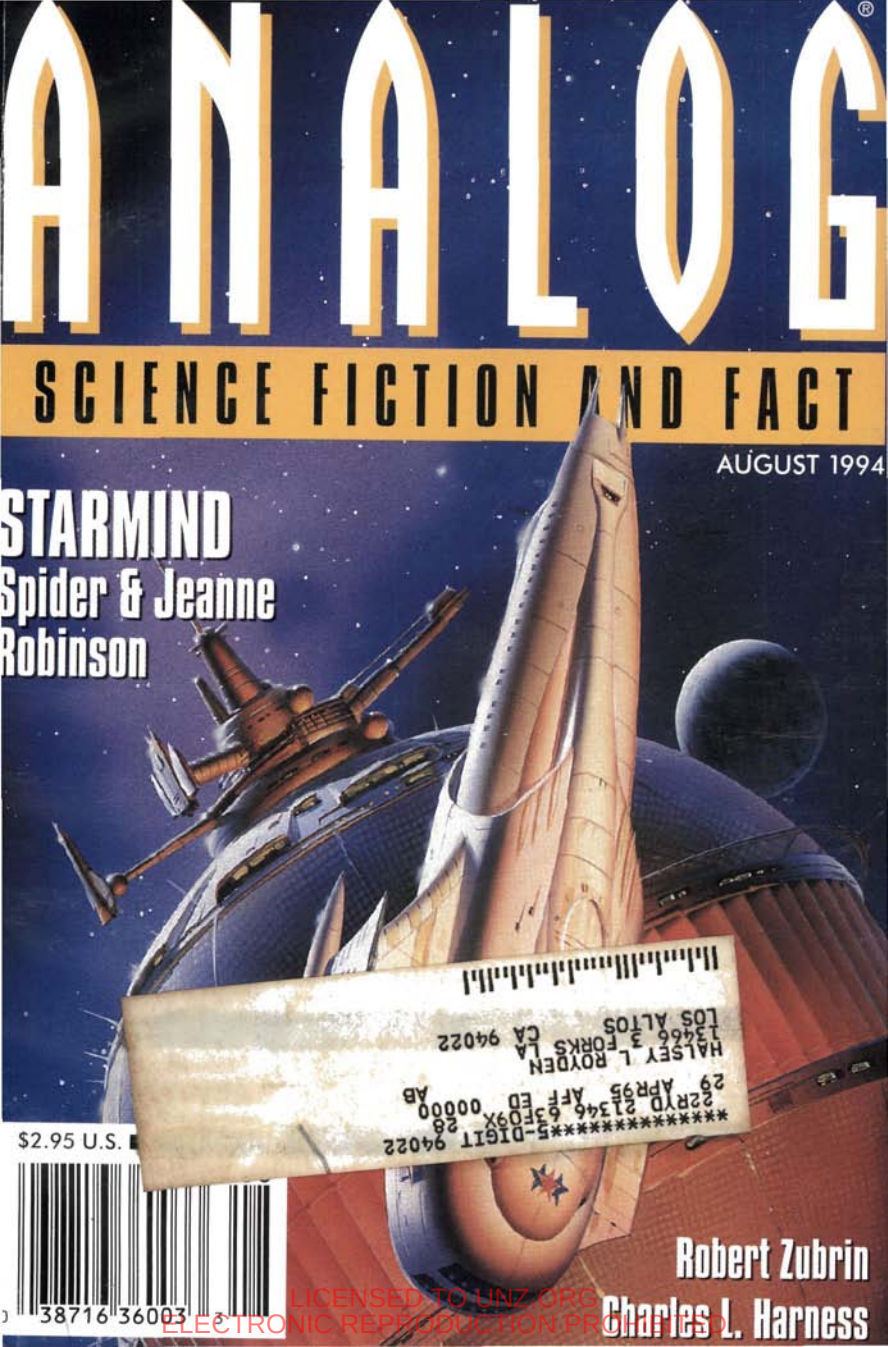

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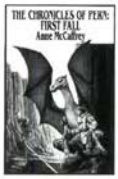

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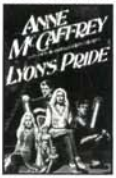

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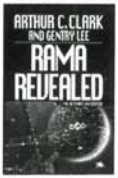

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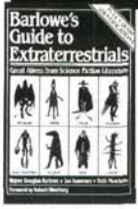

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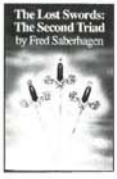

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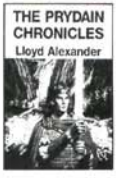

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EDITORIAL Stanley Schmidt

INTERFERENCE

It's a common assumption underlying a great deal of science fiction—so common, in fact, that readers are likely to take it for granted unless a particular story explicitly specifies a different set of ground rules. I've used it myself, as have most writers who deal with intercultural contact. The "Star Trek" series calls it the "Prime Directive."

The basic idea is simple: an advanced culture should not interfere with the development of a less advanced one. And since it's very difficult to foresee all the consequences of even a small and seemingly innocent interaction, putting the principle into practice may boil down to avoiding *any* interaction with such cultures.

But how valid is the principle? Is it really and necessarily the best guideline for dealing with other cultures? Will our descendants still think so, even if we do? And will that opinion be shared by other species we might meet in the Universe?

From our point of view, shaped largely by relatively recent experience ("recent" in historical terms, that is), such a precaution may seem eminently desirable as a means of avoiding past mistakes. Our European ancestors clearly were *not* governed by the Prime Directive. Their consequent behavior had largely adverse effects on "less advanced" societies upon which they thrust themselves. African and Amerindian cultures, for example, underwent considerable suffering as a result of their contacts, which they did not initiate, with Europeans. They got some benefits, too, such as the introduction of horses into the Americas. But it's doubtful that those benefits outweigh the introduction of new diseases and the forcing of whole cultures into subordinate roles in what had been their own lands. People who now look at the historical record often find it painful and embarrassing. It may seem obvious that in the future we must avoid such destructive intrusions by avoiding any contact at all.

But is that a newly discovered General Principle, or just a passing reaction to a moment in history? Might that currently fashionable attitude be not a mark of cultural maturity, but

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of cultural adolescence?

Not a fashionable suggestion, I realize, but it is our business here to question everything—to take fresh looks at what "everybody knows," in any area, and ask anew whether it's really true. If it is, it should withstand re-examination. If it isn't, maybe we'll find something better.

What started me thinking second thoughts about this particular question was a story I read recently that worded its "Prime Directive" just a little differently. Defining "less advanced" is, of course, a tricky business. Probably most cultures think of themselves as more advanced than others in at least some respects, and most cultures have developed much more in some respects than in others. A simple island culture, for example, may think of itself as obviously superior in morals and philosophy to technologically advanced visitors, even while eagerly embracing material goods that they don't know how to make but the visitors distribute freely. The "Star Trek" folks use space travel as a simple criterion: if the people you're visiting have it, you talk to them; if they don't, you keep out of sight (or try to).

The story I read avoided the trap of terms like "more advanced" or "less advanced" by rephrasing the principle in terms of relative age: "older" cultures shouldn't interfere with "younger" ones. And that set off a little bell in my mind that said: something doesn't sound quite right here.

My thought was that a civilization is an organization of individual animals, just as an animal is an organization of individual cells. Both animals and civilizations can be viewed as organisms, at different levels of organization. Not a new idea, of course; Robert A. Freitas, Jr., had an article about it, called "A General Theory of Living Systems," in the March 1980 *Analog*. But the observation that there are many parallels between the behavior of individual organisms and that of societies led me to ask: how do older *organisms*, such as human beings, grizzly bears, or other critters, relate to younger ones? And how valid an analogy can we draw between the way older animals treat younger ones, and the way older cultures might treat younger ones?

My tentative answers, I think, are at least thought-provoking.

In every human culture I've heard

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of, certain kinds of interference with young individuals are *required* of older ones. Interference is considered a parental or *in loco parentis* duty, under such names as parenting, nurturing, education, moral or religious training, and character development. Noninterference—letting children fend for themselves and do whatever they please—is condemned as child neglect or abuse. Simpler versions of such principles are found among many, but not all, other species. Most mammals and birds follow more or less definite patterns of caring for and teaching their young. Many "lower" animals do not. Most snakes, for example, are on their own from birth or hatching—but then, most snakes never have to do anything very complicated, and seldom have much to do with others of their own kind except brief encounters for mating.

Now, suppose we have several species of intelligent beings who have arisen independently on several planets, come into contact, and progressed to the point of organizing themselves into a "superculture" whose members are the civilizations of the various species. Unlike snakes, they interact—a lot. They are also likely to recognize that any of their members who doesn't understand and comply with some basic principles of interaction poses a potential danger to all the others. If they come across a younger civilization, not yet part of their superculture but with the potential for becoming one, they might well feel the obligation to help it develop in such a way as to become "fit for society."

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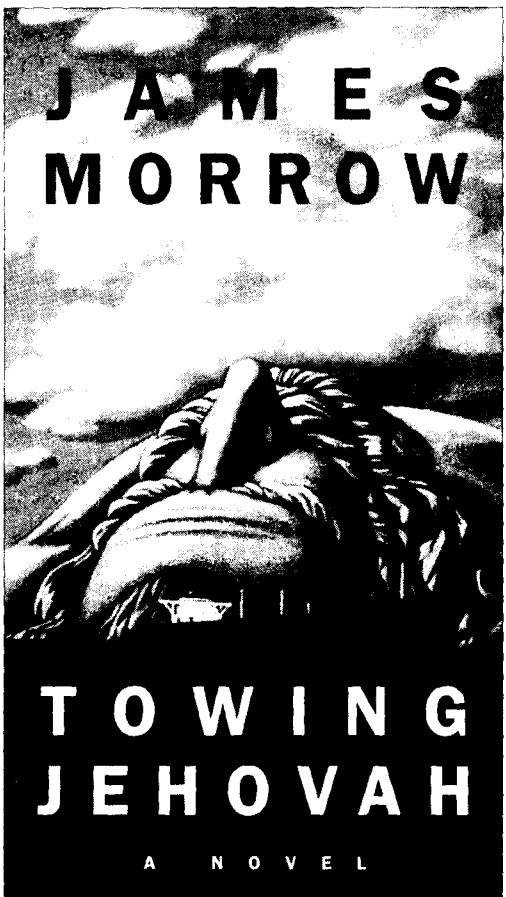

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In short, a society of intelligent civilizations is likely to regard less advanced civilizations as "young of their kind." And their attitude toward such young is likely to be far more like that of human adults toward their children than that of adult snakes toward baby snakes.

Human cultures have consistently decided that they don't dare let children grow up however they might, with no guidance or "interference." Some of the older children may think they *should,* but in a few years they'll be interfering with their children, too. They'll have learned that individuals who haven't learned any respect or consideration for others, or any ground rules for civilized behavior, are pests that they can't afford to tolerate—so they must take measures to avoid producing them. (A significant part of our present culture seems to have momentarily forgotten this, but is beginning to relearn it. It's a lesson that tends to reteach itself when necessary!) They also will have learned that, if they want their civilization to keep functioning, they must train a new generation that can make it do so—and understands why it should bother.

The analog is fairly obvious. Starfaring civilizations which have been around enough to learn some things, are quite likely to want to keep a close eye on any newcomers they encounter. Part of their motivation will be self-defense: they would rather see the newcomers develop as potential allies than as enemies. And part of it may be a sincerely altruistic desire to share what they have learned, so that the "youngsters" can achieve the advantages of civilization without having to repeat every step by their own trial and error.

This is not to say that such efforts will necessarily be "good" from the viewpoint of the young cultures being "helped," or even from that of the older culture doing the helping. My point is merely that it is more likely to *happen,* for better or worse, than current fashion often assumes. Adult humans don't always do a good job of raising or educating their young, but they do usually make some sort of effort and have some sort of effect. And history offers plenty of chilling examples of cultures (consider Crusaders and some missionaries, for example) who have done a great deal of harm with the noblest of intentions. Sincerity does not equate to merit.

What about my earlier observation that contact might best be avoided because it's so hard to foresee its consequences? That's one of the concerns that has scared so many of us into the idea that non-contact is best—we've seen those examples of how well-meant and seemingly trivial acts can have unanticipated and destructive effects. But does this mean that it's *intrinsically* difficult or impossible to foresee consequences of cultural interactions? Or might it simply mean that we haven't yet learned enough of the governing principles, and techniques for applying them, to be able to do it very well? That confederation of starfaring races, with far more experience to draw on, may have learned a lot more. They may feel more confident that they can do

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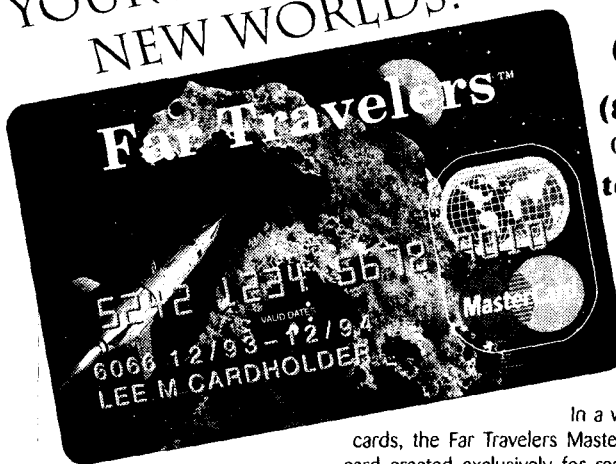

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certain things and get the effects they want without disastrous side effects. They might even be right—or they may think they can do it more expertly than they really can.

What does all this imply about *our* prospects for future contact with intelligent extraterrestrials, if any? At least two things, because contact can go two ways. First, the present widespread human assumption that "civilized" means "avoiding contact" may be just a passing fancy. If our descendants go exploring and find other intelligences out there, less developed by at least some measures than our own, I wouldn't be at all surprised to find them taking a very active interest in those others' activities, and maybe giving them a nudge here and there. If that suggestion makes you uncomfortable because it sounds like the "White Man's Burden" myth that 19th-Century empires used to justify themselves, good. Maybe if and when it happens, that discomfort will help future humans contacting other cultures to avoid at least some of the abuses of past empires. But like it or not, contact and attempts to control, or at least guide, are likely to happen. Let's hope that those making the attempts have learned enough from the past to do them more wisely and skilfully than they were often done in the past.

While we're at it, we'd better hope the same thing for the *second* implication of my speculation. That is, of course, that *we* may be the "new kid on the block" discovered by others who consider themselves older and wiser and feel obligated to take us under their wings. Maybe one of the reasons the idea of a noninterference doctrine has been so appealing is that, having seen so many disastrous examples of a "young" culture being overwhelmed by another, we fear the possibility that it could happen to us. It would be comforting to believe that any extraterrestrial civilization advanced enough to visit us would also be advanced enough to leave us alone.

But "advanced" isn't necessarily that simple a concept, and I don't think we can take it for granted! ■

Kingsbury's Law: *Nothing* can be deduced about the occurrence of intelligence in our Universe by the use of statistics until *after* we have a sample of several hundred intelligent species to work with.

Donald Kingsbury

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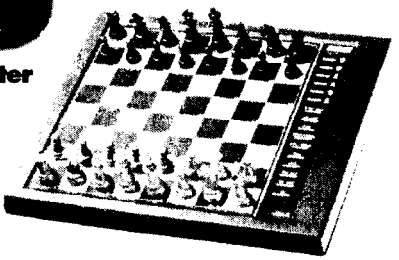

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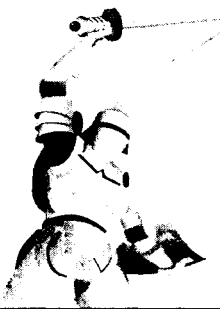

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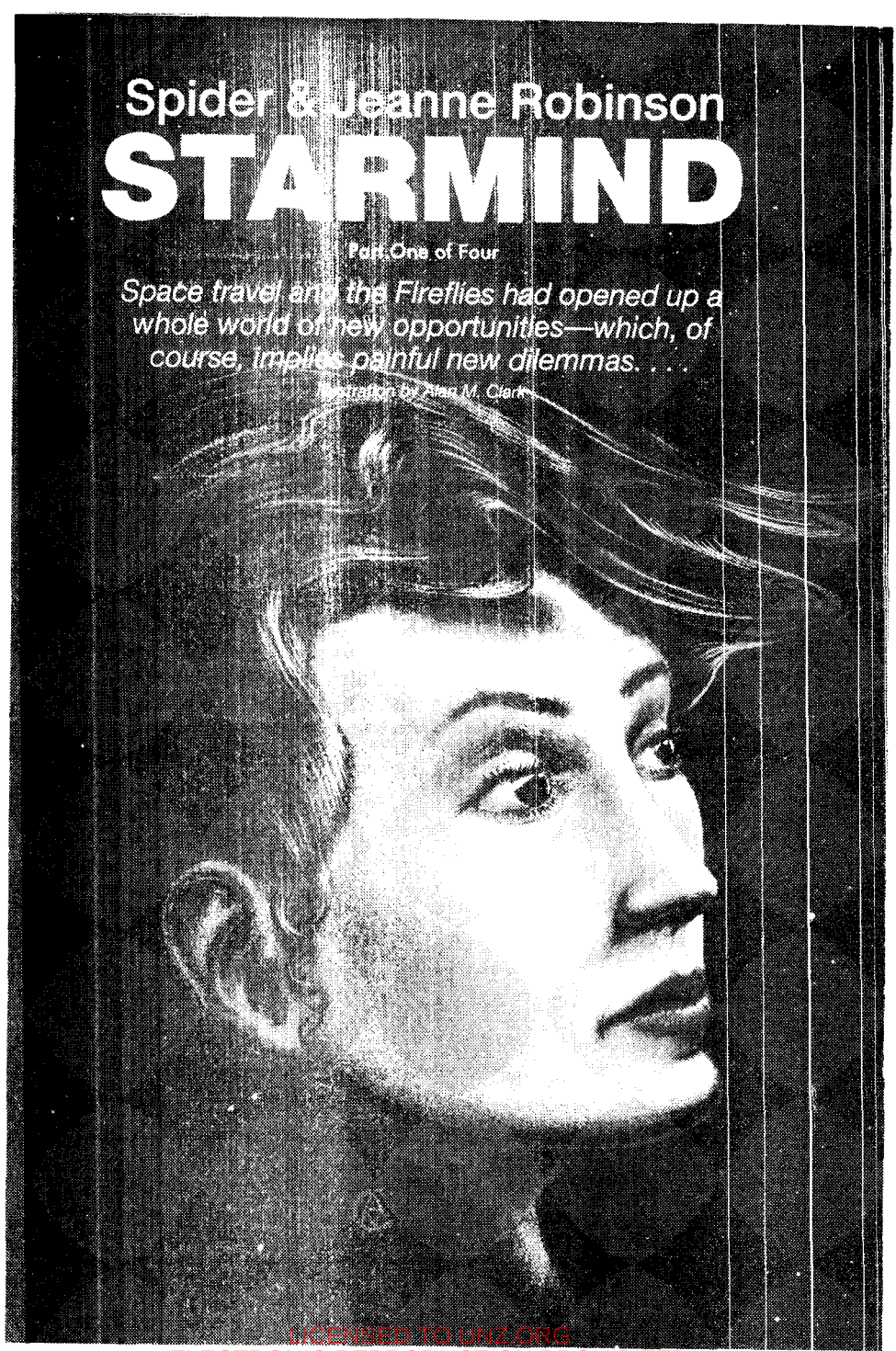
STARMIND

Part One of Four

Space travel and the Fireflies had opened up a whole world of new opportunities—which, of course, implied painful new dilemmas. . . .

Illustration by Alan M. Clark



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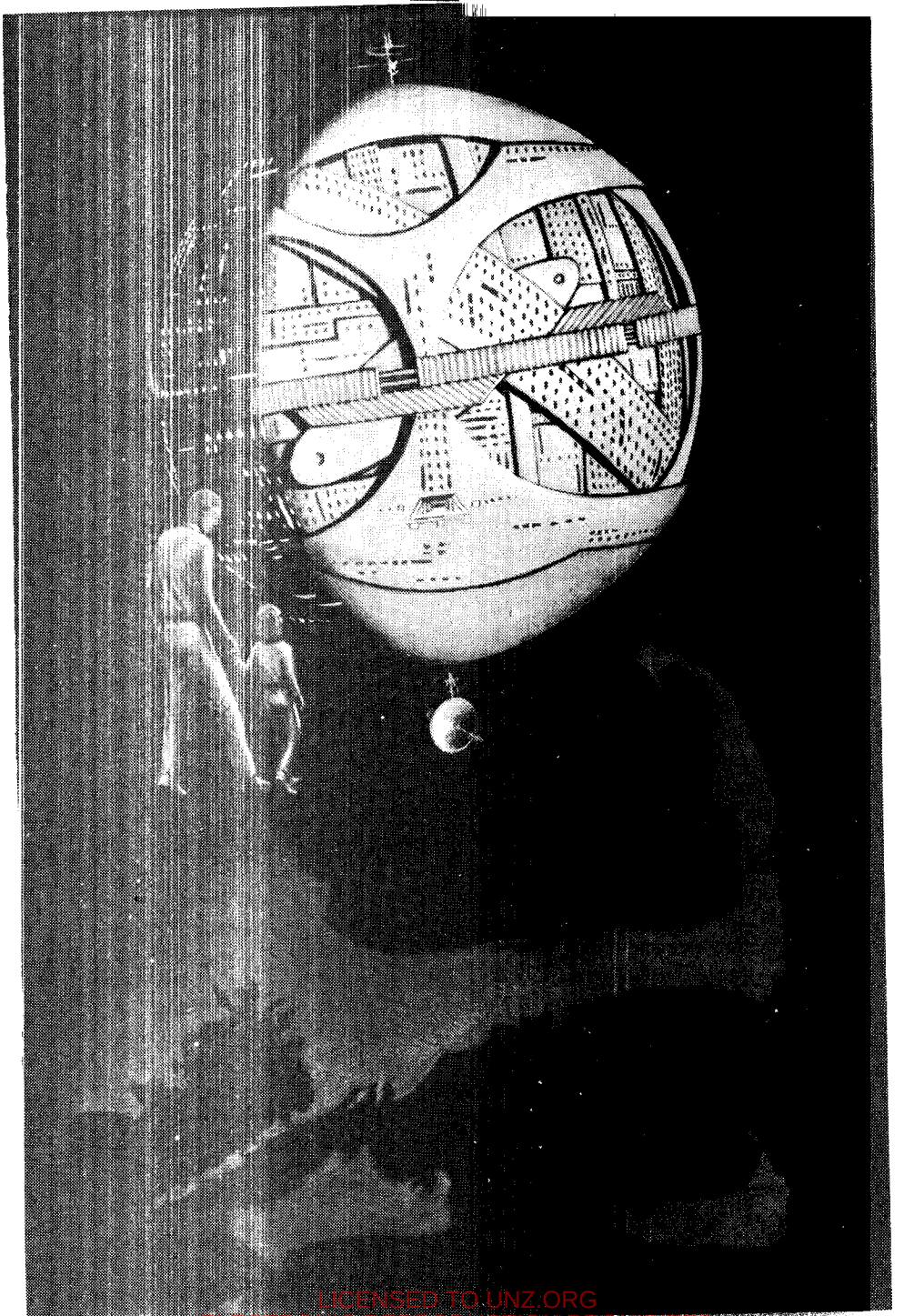

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Chapter 1

Provincetown, Massachusetts
December 1, 2064

Rhea Paixao was considered odd even by other writers. But some things are universal. Like most of her colleagues, Rhea got some of her best writing done in the bathroom.

And this was her favorite bathroom. She stopped in the doorway and examined it before entering. She had known it since earliest childhood, and the passage of time and changing fashions had altered it very little.

True, it now contained a modern toilet and bath; there was such a thing as carrying quaintness too far. But the wall opposite her was simply that, a wall, not programmable in any way: it displayed nothing, could not even become a mirror. An actual silvered-glass mirror hung on the wall, over the sink, its image speckled and distorted by surface impurities. Between mirror and sink, offset to the left, was a widget that had once been used to hold toothbrushes and a plastic cup of germ culture. Further to the left was an antique cast-iron radiator, unused in decades. The sink itself had mechanical taps, two of them, completely uncalibrated; one had to adjust the flow-rate and temperature by hand with each use. There was a depression behind the rim meant to hold a decomposing lump of phosphate soap. And slung beneath the sink was an antique seldom seen any more in 2064: a spring-loaded roller intended to hold a roll of toilet paper. (There was no roll there now, of course—but there had been for years after people stopped using the horrid stuff. Nana Fish had insisted on it. Even after she had broken down and accepted modern plumbing, Nana had insisted on keeping a roll of the Stone Age tissue handy, "just in case." She went back to the days when machinery used to fail all the time.) Every time Rhea saw that roller, she wanted to giggle.

The room was, in fact, almost a microcosm of the town around it. From its earliest days, Provincetown had always conceded as little as possible to the passing years, changing only with the greatest reluctance and even then pretending not to. That had been the town's—most of Cape Cod's—stock in trade for centuries now . . . and a good living there was in it, too. Even in these days, when "progress" was no longer quite as dirty a word as it had once been, there were still people who would pay handsomely for the illusion of an allegedly simpler time. P-Town, as the natives called it, was tailor-made for the role.

She stepped into the bathroom and let the door close behind her. No terminal in here, no phone, rotten ventilation—it was possible to make the mirror steam up—and nothing in the room accepted voice commands. In here, all three avatars of the house's AI were blind, deaf, mute, and impotent. The wind outside was clearly audible through the walls. Rhea loved this bathroom more than even she suspected. She had plotted out at least three books here, and worked on a thousand poems, songs, articles and stories. At age fifteen, she had renounced Catholicism forever in this

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room . . . sitting on that same oaken toilet seat over there!

Just like that, a perfectly good story idea popped into her head—

She gave it a lidded glance, not wanting to seem too interested, and sauntered to the toilet. It followed her, and her pulse quickened. Studiously ignoring the idea, she urinated, let the commode cleanse and dry her, and went to the sink. Again it was at her shoulder. She used her dental mouthwash, making a rude production of it, and spat noisily. The idea did not take offense.

She continued to ignore it, studied herself in the mirror. Still a couple of years to go before her fortieth birthday. Black hair, black eyes that others called "flashing," coffee-with-cream complexion. Exotic high-cheeked Portuguese features that always reminded Rhea of old 2-D pictures of Nana Fish as a girl, back in the twentieth century, an impression reinforced by the old-fashioned nightgown and robe she wore now. She ran water and splashed some on her face, rubbing especially at her eyes and cheeks and lips as though her makeup could be washed off, a childhood habit so trivial it wasn't worth unlearning. Colly was asleep, and Rand was not expecting her back in the bedroom any time soon so far as she knew; there was time to dally at least briefly with the idea. She studied it out of the corner of her eye: a short-story idea probably, really no more than a situation—but one she knew she could do something good with.

For Rhea's kind of writer, plot and theme and even character were always secondary, mere craftsmanship, constructed as needed to flesh out the story. For her, the heart of a story, the first flash that impelled and enabled her to dream up all the rest, was always that special suffering called antinomy. "Conflict between two propositions which seem equally urgent and necessary," as a professor of hers had once defined it. The juncture between a rock and some hard place. The place right out at the very tip of the sharpest point of the horns of a dilemma. Give someone an impossible choice, and *then* you had a story. Once the Muse revealed to you a deliciously impossible choice, you could begin deciding what sort of person would squirm most revealingly when confronted with it, and from that you could infer your theme, which gave you your plot.

This idea, for instance . . . .

It had been born in that brief flash of recollection she'd had as she first walked into the bathroom, of the long-ago night when fifteen-year-old Rhea had made up her mind in the privacy of this very room that she *wasn't* scared, damn it, Catholicism was *bullshit*, there *was* no God. As the adult Rhea had remembered that night, and thought of the Catholic Church for the first time in years, she'd been reminded of an artistically beautiful tragedy she knew about and had never exploited dramatically before.

Donny—Mr. Hansen—and Patty. She could no longer recall Patty's last name. Mr. Hansen had been Rhea's Sunday School teacher, twenty-three and gorgeous and devout in his faith,

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and every girl in the class had had a crush on him, but they all knew it was hopeless. Donny Handsome (as they called him, giggling, among themselves) was blatantly and terminally in love with Patty, who was also twenty-three, and just as gorgeous and devout, and just as clearly daffy about him. Together they were so beautiful—their love was so beautiful to see—that the girls in Mr. Hansen's class actually forgave her for existing.

Then, a single week before they were to be married, Patty had announced that God had called her to be a nun.

Teenage Rhea had been transfixed by Mr. Hansen's dilemma. He was a good Catholic to the soles of his feet. According to the rules he lived by, *he was not even allowed to be sad.* Not only could he not argue with Patty, try to change her mind . . . he was not allowed to *want* to. It was his spiritual duty to rejoice for his beloved, and the special grace she had been granted. He had, in the metaphorical terms of his church, been jilted for Christ, and was expected to smile as he gave away the bride.

That had been the beginning of the end of Rhea's faith: seeing Donny Handsome stumble around P-Town like a zombie, smiling aimlessly. She had refused to believe that the Universe and butterflies could have been made by so sadistic a God. Now, why hadn't she ever thought to convert such a splendidly awful antinomy into a story before?

Her craft-mind went to work on the idea now. Just put it down as it had happened? No, it was always best to change it in the telling, she found: the way it changed told you what was most important to keep. Besides, that made it art and not journalism. Did she need the Catholicism angle, for instance? Or could she change it to some other, equally inflexible faith? With celibate clergy . . . hmmmm, weren't a lot of those left any more these days. Weren't a lot of Catholics left, for that matter. Maybe it didn't even need to have religion in it at all. But if not, what else had that same implacable weight?

She tried an old trick. Refine it all down to a single sentence: the sentence that the suffering protagonist screams (even if only inside) at the moment that the point enters the belly. Then throw out everything that doesn't lead inexorably to that scream. OK, what was Donny Handsome's scream?

My beloved, how can you want to go where I cannot follow?

In the instant of that crystallization, Rhea knew what the story was really about . . . and knew that she could not write it. No matter how she disguised it dramatically. Not yet. And maybe never.

She told the story idea to get lost. Until she knew what its ending was.

She went to the window—missing the sudden chill that used to come from December windows when she was a little girl—and pulled aside the ancient curtain to look out at the night. And was rewarded. In the distance, above the shadowy housetops of P-Town, the silhouette of the Pilgrim Monument showed clearly

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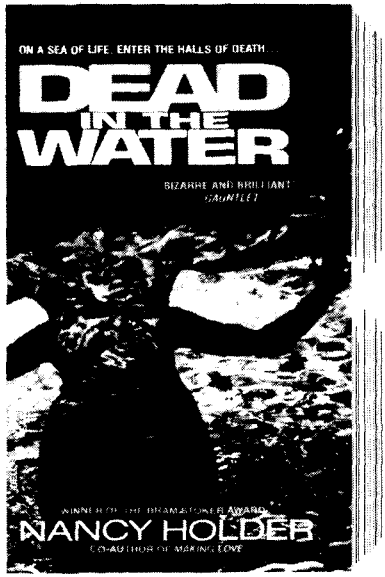
WHAT HORRIFIES YOU MOST



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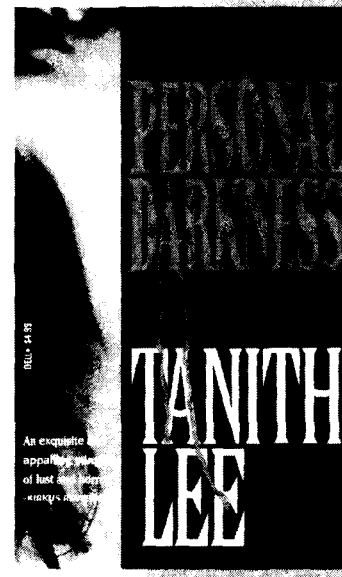

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against the night sky, an eighty-five-meter tower of grey granite—and poised beside it, midway up its length, seeming to be only meters from its crenulated stone windows, was a brilliant crescent Moon. The juxtaposition was weirdly beautiful, quintessential Provincetown magic. Rhea became conscious of her breath. It swept her mind clear—of the captive story idea and her ongoing concerns and the day's cares and her self. She watched without thought for a timeless time, long enough for the Moon to climb perceptibly higher up the Monument.

She became aware of herself then, and let the curtain fall closed. She felt a sudden close connection with the child she had once been in this room, in this house, in this town. More than that, deeper than that—a connection with the family that had raised her here, and with their forebears, fisherman and fisherman's wives, back seven or eight generations to old Francisque Henrique Paixao, who had gone over the side of a Portuguese whaler in a two-man dory off Newfoundland one cold day in 1904. He and his partner Luis Tomaz had successfully gotten themselves lost in the fog, miraculously survived to reach Glace Bay in Cape Breton, landed there without formalities or paperwork, and somehow made their way overland across the border and down the coast to Massachusetts, eventually fetching up in P-Town. The cod fishing there was as good as they had heard. After five years or so, both men had sent for their families back in Portugal, and settled down to founding dynasties in the New World—just as the Pilgrim Monument was being raised.

Rhea felt that Frank's wife Marion must have seen the Monument and Moon looking just like this more than once, and could not help listening for the echo of her ancestor's thoughts. She heard only the sighing of night winds outside.

She sighed in accompaniment, went to the mirror and ran a brush through her hair. She was ready to join Rand in bed. A month he'd been home already, and she was just getting used to having him around again. Every home should have a husband. She shut off the light with a wall switch and left the bathroom, walked down the short hallway to the bedroom. In her mind's eye she was still seeing the slow dance of Monument and Moon in the crisp cold starlight as she opened the bedroom door and stepped into New Mexico desert at high noon.

Rhea was so startled she closed the door by backing into it. The sudden sense of *distance*, of vast expanse, was as staggering as the sudden brightness. The horizon was unimaginably far away; she saw a distant dark smudge, bleeding purple from beneath onto the ground below, and realized it was a thunderstorm large enough to drench a county. Between her and the horizon were endless miles of painted desert broken occasionally by foothills and jagged rock outcroppings; close at hand were scrub hills and cacti and a dry wash. Right before her was an oasis, a natu-

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ral watering hole. Beside it was an old-fashioned wooden bedframe with a curved solid oak headboard and a thick mattress. On the bed reclined one of Rhea's favorite holostars, dressed only in black silk briefs. He was nearly two meters tall, as dark as her, and glistening with perspiration or oil. He was holding out a canteen toward her, smiling invitingly.

She discovered she was thirsty. Hot in this desert. She stepped forward and accepted the canteen. The hand that offered it was warm. He was real, then. Icy-cold water, sweet and pure. He looked even better up close. She handed back the canteen. He moved over to make room. She let the robe fall from her shoulders and drop to the sand. His eyes went up and down her slowly, as she took off the nightgown and dropped that too. She stepped out of her slippers; the sand felt strangely furry. She spun around once, taking in the vast silent desert that receded into infinity in all directions, and leaped into the bed. That started it bouncing, and it did not stop for some time.

She nearly drifted into sleep afterward, the desert Sun warm on her back and buttocks and legs. But an inner voice caused her to rouse herself and nudge her celebrity companion. Might as well get it over with. "That was really wonderful, darling," she said sleepily. "All of it. But really—purple rain?"

His famous features melted and ran, becoming the familiar face of her husband. His hair lightened to red and his complexion to fair. "No, honest—I've seen it, outside of Santa Fe. Near the pueblos. Just that color. I've wanted to show it to you." Rand reached out a lazy arm, did something complicated to nothing at all in midair, and the desert Sun diminished sharply in brightness without leaving the center of the sky. The effect was of a partial eclipse: twilight with the shadows in the wrong places. Power of suggestion made the temperature seem to drop, or perhaps he had dialed that, too; they slid under the covers together.

"I'm glad you did," she said, snuggling. "It's lovely." She looked around at the dusky desert, noting small excellences of detail. An eagle to the east, gliding majestically. Intricate cactus flowers, no two quite alike. Ripples on the surface of the water in the oasis, seeming to be wind-driven. Microfilaments of lightning, convincingly random, flickering in that distant purple rain. "This is the best one yet. Is the music this far along too?"

He shook his head. "Just some ideas, so far. But having the basic visual will help."

"I'm sure it will. It was a beautiful gift, really. The set *and* the sex. Thank you."

He grinned. "You're welcome. I'm glad you liked it."

"*Very* much. So . . . what's the catch?"

"Catch?" he asked innocently.

The reason she knew there was a catch was because it was not possible for her husband to conceal something important from her, not while making love. But she could not let him know that, so she made up a logic-chain. "It's not our anniversary. It's

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not my birthday. I don't keep score, but I don't *think* I've been unusually nice to you lately. You've not having an affair; you haven't had *time*. It was a wonderful present and I thank you for it, and—" she grinned and poked him in the ribs, "—what is it going to cost me?"

He opened his mouth as if to say something, changed his mind, and reached out into the empty air beside the bed again, typing new commands onto his invisible keyboard. The desert went away. So did everything, except the bed and themselves. All at once they were in space, surrounded by blackness and blazing stars, tumbling slowly end over end. High Orbit: the Earth swam into their field of view, huge and blue and frosted with clouds. The illusion was so powerful that Rhea felt herself clutching at the bed to keep from drifting away from it, even though she knew better. All at once the rotating Universe burst into song. Rand's fourth symphony, of course, as familiar to her as her name. He muted the sound with a gesture after a few bars, left the visual running.

It was her heart plummeting; that was what made the illusion of freefall seem so real. "But—but you're not going up again for another eight months—"

"Things have changed, love," he said. "I mean, really changed. Sit down."

"Sit down? I'm *laying* down, what the hell do you mean?"

"You know what I mean."

She lay back. "OK, I'm 'sitting down.' Go on."

"My brother called. While I was down at the shore awhile ago."

"Oh? How is Jay? Cancel that, I don't give a damn how he is: what did he say?"

"Pribhala bombed. Big-time. She hates space, the customers hate her—even the company hates her new work. But most important of all, she says she just can't adapt. She's a born perpendicular. So she's thrown in the towel . . . a few seconds before they would have yanked it out of her hand."

Rhea was confused. She knew there was a booby-trap in this somewhere, but couldn't find one big enough to justify all this buildup yet. "So that's good news, right? Now there are only three of you competing—"

"It goes beyond that," he said, looking uncomfortable. He dithered with his invisible controls until their shared rotation in space slowed and stopped. The starry Universe stabilized around them.

She took a deep breath. "Tell me."

"The competition is over," he said. "I won."

"What?" she cried in dismay. "*You* won?"

It was only that: a misplaced emphasis. Had she said, "You *won?*" there might not have been a quarrel at all. That night, at least.

Rand had been one of four competitors for a plum position: Co-Artistic Director and Resident Shaper/Composer at the legendary Shimizu Hotel, the first hotel in High Orbit and still by far the grandest. The creator and first holder of that position had held it with great distinction for fifty

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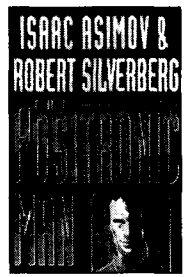
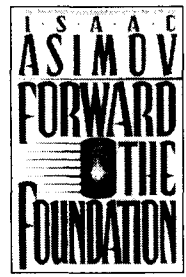
The Final Work by the Grand Master of Science Fiction





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years—then a year ago, both he and his heir apparent had been killed in the same freak blowout while vacationing off Luna. Replacing an artist of Willem Ngani's stature overnight had been a daunting task: the management of the hotel had narrowed the field to four candidates, and then found itself unable to reach a final decision. It had elected instead to postpone the question for a three-year trial period. The first year of that period was nearly over: each of the four candidates in turn had gone to space for a three-month residence at the Shimizu. Rand had drawn the third shift, and had only returned from his own highly successful season a month earlier; the fourth and final composer, Chandra Pribhala, was supposed to be just now entering the second month of her own first residency.

But Pribhala had turned out to be a "perpendicular"—one of those rare unfortunates who simply cannot adapt to space, who cannot make the mental readjustment that allows a human being to retain her sanity in a sustained zero gravity environment. She had abruptly canceled her contract after only a single month in free-fall, accepting the huge penalties and creative disgrace, and returned to Earth early.

This left the Shimizu's management with a quick decision to make. A hotel must have entertainment. The show must go on. The Resident Choreograper—Rand's half-brother Jay Sasaki—needed a Shaper to collaborate with. *Someone* had to replace Pribhala, fast. They might have simply advanced the rotation schedule, summoned Wolfgar Mazurski back to orbit two months earlier than he was expecting, and continued from there on a three-shift rotation while they pondered their final decision. But Mazurski had other commitments, and so did Choy Mu Sandra, the other contender.

Which left Rhea's husband.

But Rand was only just back from orbit. Returning to space for another three-month shift this soon would raise his total free-fall time to six nearly consecutive months in one calendar year: very likely enough time for his body to begin adapting—completely and permanently—to zero gravity. It would take fourteen months for the transition to be finished . . . but deleterious metabolic changes often began much sooner. If they asked him to replace Pribhala now, the competition was over: they would have to give him the permanent position to forestall a costly lawsuit.

The Shimizu management had little choice. And Rand's first season *had* been the most well-received of the four so far. So they had sent word, through his half-brother Jay. The job was his if he wanted it—along with a scandalous salary, outrageous perks, immense cachet, and luxury accommodations in-house for himself and his wife and daughter. For life—which was how long they would need them.

Rhea hated the very thought of moving.

And if she *were* going to move, space was the very last place she'd

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pick. The only one-way ticket there was. Fourteen months or more in space, and you had to stay there forever. You couldn't even *hope* to go back home again someday . . . .

Worse, Rand knew all this. Or at least, he should have known. A decade ago, he had solemnly promised Rhea—as a condition of marriage—that he would never ask her to move away from her beloved P-Town, from her home and family and roots.

When he had first mentioned the possibility of this job, she had been shocked and hurt. But she had not reminded him of his promise . . . partly because she loved her husband and knew how badly he wanted the job, and mostly because she *knew* in her heart that there was no way Rand would ever actually be offered it. That had been clear to her from the start. For one thing, his blood-relationship with Jay would work against him—allowing disgruntled losers to cry nepotism. For another, he was the most talented of the four—traditionally a handicap. To nail it down, he was by far the least political—traditionally the kiss of death.

Ironically, it was that which had clinched the deal. Mazurski and Choy *each* had a powerful and influential clique of friends, skilled at vicious infighting: they canceled each other out. Rand was the only choice everybody could (barely) live with. And so it was the very same aspect of her husband's character which had in fact won him the job, that caused Rhea to say to him now so injudiciously, "*You* won?"

The ensuing quarrel was so satisfactory a diversion that it was a full hour before they got around to the actual argument they had been avoiding for over a year now.

"Goddamn it, Rhea, just tell me: what's so awful about space?"

"What's so fucking good about it?"

"Are you kidding? Sterile environment, pure air, pure water, perfect weather all day every day, no crime, no dirt, longer lifespan—and weightlessness! You don't *know*, honey, you haven't been there long enough to get a feeling for it; everything is so easy and convenient and restful in space. Nothing is too heavy to lift, nobody's a weakling, your back never hurts. And the freedom! Freedom from the boredom and tyranny of up and down, freedom to live in three dimensions for a change! To use *all* of a room instead of just the bottom half—to see things from different angles all the time—to let go of something and not be afraid gravity's going to smash it against the wall by your feet. Put that all together, throw in a better class of neighbors and the best view God ever made, and it doesn't sound half bad to me."

"It sounds horrible to me! The same weather, *every day?* The first thing you said: 'a sterile environment,' that's exactly what it sounds like. Living in a sterile tin can surrounded by cold vacuum, breathing canned air and peeing into a vacuum cleaner. What about Colly? Where's an eight-year-old going to find playmates in space? Think about never

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again going out for a walk, never getting rained on or snowed on or going to watch the Sun rise—"

"—The Sun rises fourteen times a day at the Shimizu—"

"—It's not the same and you know it—"

"—No, it's not the same, it's better—"

"—Bullshit—"

"—How the hell would you know? You were up there for three whole days! I'm telling you, I've been there for three months and it's better—"

"—*Maybe it is, but it's* different, *goddamn it*—"

He flinched at her vehemence. After a few seconds of silence, he slapped at the control panel, and set the Universe spinning around them again. "What's so bad about different?"

She reached irritably past him and felt for the keyboard, found it, and quit the holo program abruptly. Blink: they were in their quaint comfortable moonlit bedroom in their magnificent old home in picturesque P-Town. "What's so bad about what we have?" she cried, gesturing around her at hardwood floor and lace curtains and quilted comforter and scrimshaw and Frank Paixao's barometer and fading photographs of Nana Fish and Nana Spaghetti on the walls.

He looked round, at the familiar trappings of their marriage, of their shared life. When he spoke, his voice was softer. "It's good. You know I love it here too. But it's not all there is."

"It is for me!" she said. *Oh my beloved, how can you want to go where I cannot follow?*

He closed his eyes and took a deep breath, and played his hole card. "It isn't for me."

She clutched his shoulder and played her own. "You promised, Rand! Back when you first asked me to marry you, you promised...."

There was nothing he could say to that, because it was true. She had him dead to rights. The argument was effectively over, now. She had won....

...And cost her beloved husband the professional and personal opportunity of a lifetime, the crowning achievement of his career....

He nodded, and rolled over on his right side, back to her. "When you're right, you're right," he said very quietly, and mimed preparing to sleep. But his shoulder blades were eloquent.

She savored her triumph for as long as she could stand it, staring at the ceiling. Then, keeping her voice as neutral as possible, she said, "Anyway...how would we deal with Colly's education?"

His shoulder blades shut up in midsentence.

"Well—" he said finally, and rolled over to face her.

Chapter 2

Rand Porter had been waiting for that question, of course. Their eight-year-old would get a *better* education if he took the job; Rhea had known that when she asked the question. On his new salary, they could afford to enroll Colly in any school on or off Earth, with full bandwidth and as

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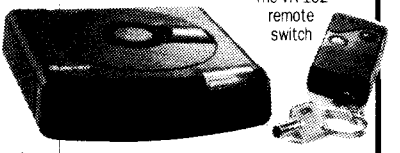

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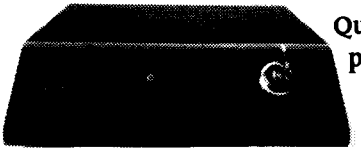

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much individual attention as she wanted. Hell, they could afford to have teachers physically brought up to her if they wanted, in corporation shuttles. And Rhea could have Unlimited Net Access herself too.

And all these things, he added, would be merely perks—over and above a salary so immense that they could easily have afforded to pay for them. Full Medical would be another such perk. Rhea's literary reputation could only benefit from all the publicity that would accrue. Rand stressed all these points, without ever quite saying aloud a point that mattered to him almost as much as the honor or the creative challenge or the prestige or the money *per se*:

If he took this job, he would be earning more money than Rhea, and would be more famous than she. For the first time in their relationship.

He *couldn't* mention that aloud. They had agreed back at the start that they would never mention it; that was how little it meant to them; therefore he couldn't bring it up now.

"Worse came to worst, why couldn't we compromise?" he suggested desperately. "Have one of those commuter marriages? I'd take the job, and you could come up for three months out of every six. Lots of people do that, when only one half of the team wants to be a spacer."

"Sure," she said. "That worked out just great for your brother, didn't it?" Jay had maintained such a relationship with a dancer in one of his two rotating companies for over five years—then about six months ago, Ethan had sent him a Dear-Jay/resignation fax from Fire Island. The scabs were just beginning to turn into scar tissue.

"We're more committed than Jay and Ethan were," Rand protested. But privately he was not sure this was true—and the stats on groundhog/spacer marriages *were* discouraging.

When they were exhausted enough, they agreed to sleep on it.

At five in the morning he slipped from the bed without waking her and went down the hall to his Pit. Strains of melody were chasing each other in his head, but when he booted up his synth, he could not isolate any of the strands in his headphones. Aloud, they were an inseparable jangle of discord—like his feelings.

So he went to the kitchen, and found he was not hungry. He went to the bathroom and discovered he didn't have to pee. He put the headphones back on and learned that he didn't want to hear anything in his collection. He went up to Colly's room and found that she didn't need to be covered. As he bent to kiss her, he startled himself by dropping a tear on the pillow next to her strawberry-blonde hair. He went quickly back downstairs to the living room and wept, as silently as he could. When he was done, he dried his eyes and blew his nose.

What *did* he need?

That was easy. He needed someone to tell him he wasn't a selfish bastard.

He had promised her. Worse, he had thought about it first. He had not specifically envisioned this situation, no, but he had made his promise

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without reservations. *No matter what, love—*

But this offer was beyond any dreams he'd had a decade ago. How could he have known? The carrot was irresistible. . . .

Or was it? What was so irresistible? The money would be great—but while they had been middle-class for their whole marriage, they had never been poor, never missed a meal. There were other jobs. Indeed, this was about the only job he could possibly take that would require them to move from P-Town, that he couldn't basically phone in. It was certainly the only job that would have required *permanent* exile. What was so great about the damn job?

Two things. It was the most prestigious job in his field, one of the most prestigious there was. And it would make him the principal breadwinner in his family, for the first time.

Not very proud reasons to break a solemn promise to your wife . . . .

No, damn it, there was more to it than that. The job was the richest creative opportunity he had ever had. His three-month stint just past had been the hardest work he'd ever done . . . and had drawn some of his very best music and shaping out of him. Collaborating with his half-brother Jay had been exhilarating; although Jay was thirteen years older than Rand's thirty-five, their minds had meshed.

I see: your wife will be a little sadder, but your chops will improve . . . .

It wasn't just that. Part of what had made his work better in the Shimizu had been the heart-stopping grandeur of space itself, the bliss of zero *g*. Space was as magical as Provincetown, in a different way; maybe more so—surely Rhea would see and respond to that, just as he had.

You hope . . . .

Anyway, what was so great about P-Town? OK, it was beautiful; sure, it was timeless; granted, it was magical. This chair he was rocking in, for instance: beautiful and timeless and magical. But it made noises like rifle fire, and leaned ever so slightly out of true, and wasn't especially comfortable without pillows that always slipped out of adjustment. So what if it had belonged to Rhea's great grandmother? So what if it had been the chair in which the infant Rhea had been breastfed . . . and Colly too?

The answer was all around him—hanging from every wall, perched on nearly every flat surface. Pictures of eight generations of Paixaos, as far back as imaging technology allowed, ranging from faded black and white daguerreotypes of Cap'n Frank and Marion to paused holoblocks of Rhea, Colly and himself. Hundreds of Paixaos and their kin, in dozens of settings, and every single image had Provincetown somewhere in the background. Beautiful. Timeless. Magical . . . .

On the mantle, amid the more recent Paixaos, was a holo of Rand's parents, Agnes and Tom, taken just before their divorce. The background was Newark, New Jersey.

There was no point to this: he already knew he wanted the job badly enough to take it; whether he *should* want it that badly or not seemed irrel-

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evant. Nonetheless he flogged himself, as his penance, endlessly replaying the argument until it became a loop that annihilated time.

I want to be great. Is that so terrible?

Just as he felt that his brain might explode, thirty-five kilos of eight-year-old reality landed on his lap like a tonne of bricks, shouting, "Boo!" and his heart nearly exploded instead. Daylight and his daughter had crept up on him.

"I scared you, Daddy!" she reported with glee. "I did, didn't I?"

For an instant he was tempted to use Colly as a new club to beat himself—*how can you ask a child to go pioneering?*—but he shifted gears instead, grabbed her in his arms and stood up. "That you did, baby," he said, clutching her close. "That you did."

"Did you catch it, Daddy?"

"Huh?"

"Whatever made you stay up all night. Did you get it?"

"Oh. Uh . . . not yet, sweetheart. I got a look at it, but it got away."

"Don't matter about it," she advised him. "You'll get it next time."

Her optimism—and the boundless, unquestioning faith that underlay it—floored him. *I can't be a bastard,* he thought. *I'd never have fooled her.* He hugged her even closer, making her squeal. "That I will," he agreed. "Right now, let's you and me get us some grub."

"I cook," she said quickly. Her faith in him had practical limits. That was why he could trust it.

"Deal," he agreed.

And she did cook a better breakfast than he could have—albeit somewhat more messily. Rhea came in while she was doing it, and stood in the doorway in her bathrobe watching and trying not to smile. Colly refused to let either of them help, or even coach. By the time they were all sitting down eating together, it seemed to have been decided that today was a happy day. Rhea's eyes were unguarded when they met his. The Issue was still there between them, but it was on hold for the moment.

After the meal, it was Rhea who said, "Colly, sit back down. You can be a little late for playgroup today. Your father and I need to talk about something with you."

"Aw, Mom—do you have to? Sarah's gonna bring her cat in today, and she swears it has thumbs!"

"Yes, honey, it's important."

"Four of 'em! Oh, OK, go ahead." She sat back and adjusted her nervous system to fidget mode.

Rhea handed the ball to him. "Rand?"

He cleared his throat. "Colly . . . have you ever thought about . . . living somewhere else?"

"You mean I'm going to grandma's house again? How long this time?"

"No, honey, that's not what I meant. I mean . . . all three of us, moving away from here, to a new home."

"And not coming back?"

"That's right. Not ever."

The notion did not seem to shock Colly. "Where?" she asked practically.

"Well, remember that time we went to visit Uncle Jay?"

She got excited. "Go to space, you

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mean? And stay there? In that cool hotel? Oh, wow!"

"You really liked it that much?" Rhea asked, surprised.

"Da! Si! Ja! Oui!" Colly said. *"I'm not little in space!"*

Both parents were startled into laughter.

"It's true," she insisted. "I can reach everything there, and look grownups in the eye, and I'm as strong as anybody and not clumsy like everybody else. Besides, it's *fun!* When do we go?"

Even Rand was taken aback by support this enthusiastic. "But baby, you know if we stay in free-fall for long, we have to stay forever?"

"Sure."

"Well . . . won't you miss your friends?"

She thought about it. "I could still call them up, right? We could holoplay. And they could come visit me realies, sometimes. And I'd make lots of new friends. I'm good at that."

Rand squelched a grin. "Well . . . yes, you are. But won't you miss . . . this house, and P-Town . . . and everything?"

"And the beach?" Rhea prompted. "And the ocean?"

Colly looked around her. "I guess. But if I do, you can just make it for me, Daddy. Anyway, you can't play six-wall here. I tried."

He didn't have to look at his wife to know that she was looking faintly stricken. Her only potential ally had defected. He wanted to put an arm around her, but was not sure whether that would make it worse.

Colly had gone from fidget to bounce mode. "Can I go tell everybody now, Daddy? How soon are we going, Mommy? I gotta go get dressed! Oooh, Kelly's gonna be *so* jealous—"

"Hold your horses, young lady. Nothing's been decided yet. Your mother and I are still discussing the idea—"

Colly wasn't listening. Her eyes had gone wide. "Wait a minute—this means you got the job, didn't you, Daddy? You get to work with Uncle Jay now! They picked you! Oh, I knew they would! I *told* you they would!"

Rhea winced.

"We are going, we are! Can I go tell Kelly now? And Sigrid? And Bobby?"

The choices were let her go or strap her down. "Maybe you better get dressed first," Rhea said.

Colly looked down at her rumpled pajamas, and giggled. "Oh, OK, if you insist," she said, and ran for the stairs. She was naked before she reached the top.

Rand and Rhea looked at each other. Each waited for the other to speak, with voice or expression.

"We have to laugh," he said finally.

"Oh yeah? Why?"

"Because if we strangle each other, who's going to take Colly to playgroup?"

And so they laughed.

"Come on, somebody," Colly called from upstairs. "Get dressed! I'm almost ready already!"

They laughed harder, and then got up together and sprinted up the stairs, shouting, "Yes ma'am! Right away, Your Highness!"

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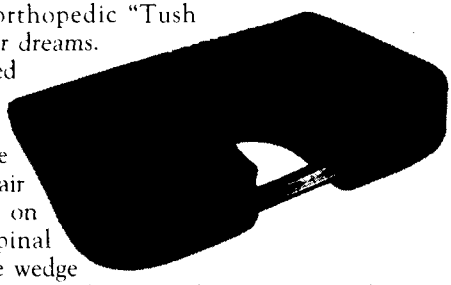

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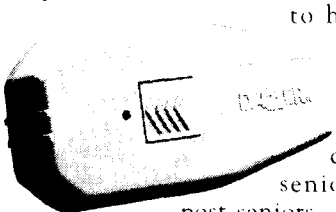

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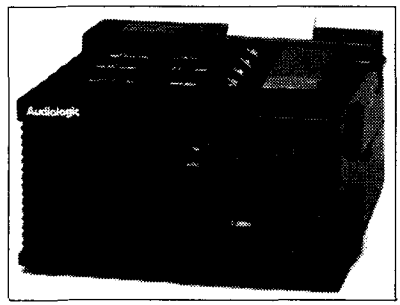

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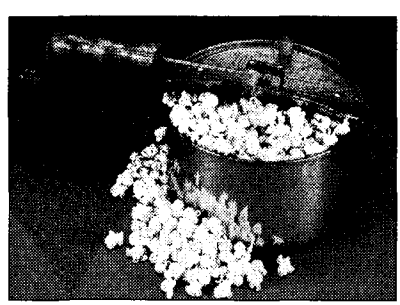

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"I still don't see why you have to *live* there," Rhea said thirty minutes later. They had dropped Colly off at playgroup in the West End, and now were sitting in the car at the edge of the sea at Herring Cove, half-watching a group of eight or ten Trancers in sleek thermal clothing dancing on the shore, spinning and jumping in the December breeze, falling and recovering but always springing back up at once. They made Rand think, as always, of birds trying to batter their way through an invisible ceiling. Provincetown had been a magnet for Trancers since the strange fad had begun and spread around the planet with the speed of a catchphrase. P-Town had always been a Mecca for all kinds of odd behavior.

"It's stupid," Rhea went on. "It's just stupid elitist thinking. There's no sensible reason why you can't phone it in, like any other job. They only *have* the best holo gear in human space."

"That's what the Shimizu is all about," Rand said patiently. "That's what they're buying. The most conspicuous consumption there is. Nothing canned, nothing piped-in—"

"I know, I know—the celebrity artists are all on-site for the customers to press the flesh with, and half the robot-work is done by human beings, just to prove they can afford to waste money. Snob logic."

"You can't make art for a place without going there," he said. "Holo isn't enough. I can't explain why, but it isn't. I always go to the site if there is one, at least at first. You know all this."

"So you've *been* there for three months! Isn't that enough?"

It was a fair question. He tried to find the words to answer it. All he had come up with was, "Space is different."

"Different how?"

"Look: you were there."

"For three days."

"Long enough to get a taste. Now, tell me: can you remember what it was like?"

She started to answer, then stopped. "No," she said finally. "I can remember what I told people about it. I can remember what I wrote about it. But no, you're right. I can't remember what it was like. Not really. I have a lingering feeling about it—"

"If you had to write a poem about it, right now, could you? Or a story set there?"

Her shoulders slumped. "I'd have to go back. For longer than a few days. And either write it there, or right after I got back down."

"That's why Ngani bullied the board into putting in writing a provision that his successors would have to live in-house. And that's why Jay bullied them into honoring the agreement when Ngani died."

This was all old ground. They had had this conversation over a year ago, when he had first become a candidate for the position. He saw her momentarily as a trapped animal, doubling back on its tracks in search for a way out overlooked earlier, and felt a pang of guilt.

She gestured at the ocean and half a

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world of clouds, at the crazy Trancers moving in harmony—then turned and gestured in the other direction, at P-Town. "And all of this, we're supposed to give up, forever, so that Willem Ngani's artistic vision isn't violated?"

The question was so unfair that he returned fire with some irritation. "Only if we want me to have the job."

She left the car and walked a short way along the beach, past the gyrating dancers. By the time she returned, he had cooled down and she looked chilly despite her thermally-smart clothing. The Trancers too had finally run out of manic energy, and were dispersing, looking blissed-out.

"How about this?" Rand said, as the car heater switched on to normalize the temperature in the vehicle. "We give it a couple of months. I'll complete Pribhala's season. Then if you absolutely hate it, I'll quit."

"You couldn't break your contract!"

"Hell, Pribhala did. I'll reserve the right. If they want me bad enough, they'll negotiate. It's perfectly reasonable—considering they're wrecking my whole schedule with no notice at all. By rights they ought to be paying me a whopping bonus. If they don't like it, let 'em give Mazursky and Choy socks full of dung and let *them* fight it out."

She thought about it. "Huh. Two more months wouldn't be long enough to change you into a spacer. And it's long enough for me to form an opinion . . . ."

"I promise if you want to come back, there won't be an argument."

The device didn't fool either of them; he could see that in her eyes. But it brought the situation a little closer to tolerable. It would buy some time.

"How soon would we have to leave?"

"I'll call Jay."

Chapter 3

Yawara
Queensland, Australia
2 December, 2064

At about that moment, not too far from the opposite point on the planet's surface, an old—no, ancient—woman switched off her ancient compact disk player, brushed the headphones out of her hair with a palsied hand, and decided it was time for sleep. Or at least for bed. Slowly and carefully she got up from her rocking chair, then used it to steady her while she removed the denim shorts which were her only clothing. She walked with halting steps through the darkness to her bed, but when she reached it, she dropped easily and comfortably into a squat beside it. Reaching beneath it, she drew out her chamberpot and removed its lid. When she maneuvered it beneath her, its weight and a small sloshing sound reminded her that she had forgotten to empty it that morning. As she was about to put it to its accustomed use, she suddenly stopped, clamping her sphincter and flaring her nostrils. Her head turned from side to side, twice. Then she looked down between her legs, bent her head lower and sniffed. She took the chamberpot from beneath her

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and brought it to her nose and sniffed again.

She *knew*, then, but nonetheless she reached up and got matches from the bed table. In the sudden flaring light, her eyes confirmed what her nose had told her. Her chamber pot contained wine.

It delighted her. It had been a long time since anything had surprised her. This was a good one. She thought about it, savoring the puzzle. No one had approached her home closer than a hundred yards all day. She had not left it for a moment. She had *not* emptied the utensil after using it that morning, she was sure of that. She might be old—no, ancient—but her memory was still as sharp as the long edge of a war boomerang. There was no logical explanation . . . so she went inside herself, to her special place.

And at once, contradictory things happened on her face. Her eyes brightened, and bitter tears spurted from them, and years—no, decades—melted from her visage, and her mouth smiled while her brows knotted in a fierce frown. She glanced across the room at her CD player, and ran a hand across her head to confirm that she had taken its headphones off. *"Badunjari . . .?"* she whispered, and cocked her head as if listening.

Whatever she heard caused her to smile even wider and weep even harder—but the frown relaxed. She sat back on her heels and began to rock slowly from side to side. After a time, she lifted the chamberpot to her lips and drank from it. The wine was excellent, delicious, and immediately powerful. She took a deep draught.

"Really?" she said in Yirlandji. "What is?"

If there was an answer, no microphone could have recorded it.

Her tears ceased; the smile remained, and became the mischievous grin of a little girl. "OK," she agreed. and drank again. "I will wait and see."

She had not been this happy in forty-four years. Magic, real Dreamtime magic, was loose in the world again . . . .

Chapter 4

Shimizu Hotel, High Orbit
December 2, 2064

Jay Sasaki was in the studio when his AI spoke up. "Phone, Jay: your brother Rand, flatscreen only." It waited patiently while he finished a movement phrase for the camera and toweled off sweat.

"Thanks, Diaghilev," he said then. "Monochrome headshot, minimum audio, accept." It was the cheapest possible Earth-to-orbit call, small black and white image and rotten sound, probably relayed on a satellite circuit so old its expiry date began with "19." Rand would have been offended if Jay had tried to reverse the charges—and it was not yet settled whether his kid half-brother could afford to make fullscreen color calls to High Earth Orbit on his own dollar. Jay spoke before the AI finished producing an image, to let Rand know the circuit was completed. "Well, how did she take it?"

"She's right here," Rand said. "Ask her yourself." He swiveled the carphone so that Rhea came into frame. She was smiling wryly.

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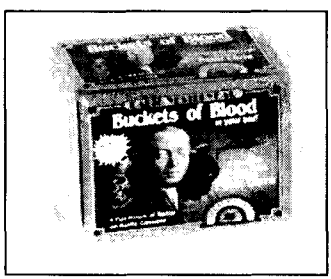

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"'Oops,' he said gracefully," Jay said. "Hi, Rhea. Well, how did you take it?"

"Rectally," she said sourly.

The joke cued him—first, that Rand would indeed be coming back up to work in The Barn . . . and second, that it would not be a good idea to sound too delighted just yet. Was Rhea coming up with him right away? Was Colly? "You'll really like it up here, I promise you," he said experimentally.

"I'd better."

Good. Rand would arrive still married. "And Colly will love it. Space was made for kids."

"It must be," she said. "You like it." But she was smiling.

He relaxed, trying not to let the extent of his relief show. The worst that could happen now was that his half-brother's wife would make Rand's life miserable to the end of his days. *But he'll be able to work with me again!* It would take a lot of the sting out of Ethan not being around anymore . . . .

"We're going to give it a trial period," Rand said. He swiveled the phone again so that he was back in frame. "Two months, so Rhea and Colly can check it out before they commit themselves."

Jay managed to hold his poker face. Fortunately, in zero gravity one's face does not pale as blood-pressure drops. If Rhea left in two months, Rand would go with her. With the example of Jay's own disaster with Ethan before him, Rand would not risk losing her in a long-distance marriage. Kate was going to have a blowout when she heard this. "That'll be hard to sell to the board. They want this settled. Face, you know."

"I've got face, too," Rand said. "I require notice before uprooting my family. If the board doesn't like it, they can start running want ads in the trades."

Briefly, Jay fantasized telling his brother the whole truth. The primary reason the board had abandoned the audition process and chosen Rand as their shaper was that Jay—feeling reckless in the aftermath of his breakup with Ethan—had privately sent word through the hotel manager that he would quit if they did otherwise. He had just enough clout to pull that off . . . and no margin at all: if the hotel came out of this looking bad, he was out of a job. He was the most famous living human choreographer of free-fall dance—but if he left the Shimizu, where could he go? There were only two other dance companies in space, and neither was hiring. Jay had been a spacer, permanently adapted to zero gravity, for over a decade now: if he could not work in space, he could not work—even if he could have learned to think and choreograph in up-and-down terms all over again.

No—he couldn't tell Rand any of this. If he did, Rand would think—would suspect in his heart forever, no matter what Jay said—that Jay had put his job on the line purely and simply because they shared a mother. Rand would never believe the truth: that he was truly the only one of the four candidates who was any damn good, the only

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one Jay could stand the idea of being locked into working with for the next umpty years. The hole in his self-confidence would founder him. And the realization that Jay's job *was* on the line would make his problem with his wife even worse.

Well, it was up to Jay to see that Rhea didn't opt out. His other choice was to slit his throat. "You're absolutely right. I'll make them see it that way. Shall I call you back with their answer?"

Rand shook his head. "We both know they're going to say yes. I can afford to call *you* now. Full-band color."

Jay let the grin escape at last. His brother was right. Kate would hate this—but she was committed. As committed as he was. "Damn right. Call me back at . . . what the hell time is it down there?"

"About ten in the morning." The Shimizu was on Greenwich Time; it was nearly 3 P.M. for Jay.

". . . At about suppertime. Listen, I don't want to crowd you, but . . . how soon can you come up? The sooner you can make it, the less trouble I'll have selling this trial period."

Rand acquired the harried look of someone who is trying to solve a tricky problem while long-distance charges are ticking away. He glanced sideways. "What do you think, hon?"

After a time, Rhea's voice came from out of frame. "Three days, minimum. I'd like a month. I'd like a year, dammit."

"I think I can get three days, no sweat," Jay said cheerfully.

Rand tried for a diversion. "Anything we can bring up for you?"

"If I think of anything, I'll tell you when you call back." He gave the phone his best grin. "Listen, this is really great news. Really, Rhea—you'll see! Kiss Blondie for me. Phone off." As Rand's smiling image dissolved, he went on, "Diaghilev, where's Kate?"

"In her office, Jay. Do you wish an appointment to see her? She has an opening in her calendar tomorrow at—"

"No, I want her now. She'll see me. ETA fifteen minutes."

"Yes, Jay. You're right: Ms. Boswell has accepted for her. Fifteen minutes from . . . mark."

"Shower, please, Diaghilev."

"Yes, Jay."

The studio shower accepted and cleansed him; ten minutes later he was dry, shaved, groomed and jaunting along the corridors of the Inner Sphere, heading inboard toward Katherine Tokugawa's executive office in the Core.

Heads turned as he floated past, but only one of the hotel guests had the nerve to call out to him. "Hello, Jay. You look happy—good news?"

Jay made a long arm and grabbed a jaunt-loop, braked himself to a halt. His boss would have a fit if she ever heard that a mere guest had learned news of this importance before she did—but Eva Hoffman was more than just a guest; she had been a resident fixture in the Shimizu for sixteen years now. He glanced around mock-conspiratorially. "Are you *sure* those are your original eyes?"

Eva grinned. She was 116 years old,

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and showed more than half of them—having, most unusually, given up controlling her appearance on her hundredth birthday. She drew stares everywhere she went in the Shimizu these days... the most horrified of them coming from those guests whose own odometers had rolled past zero. "Thirty years ago I'd have known exactly why you were looking happy, at twice the distance. So your brother's coming back up to stay, eh? Congratulations."

"Thanks. I'm excited."

"Me too. You two do good work together. Pribhala was a waste of air."

"She... had her own way of doing things."

"Yeah. Wrong. Would you like me to take charge of his wife and daughter? What's her name, Spaniel?" Eva, of course, knew perfectly well what Colly's name was. "Help them get reoriented to free-fall, their first day, show'em around the Mausoleum, and all that, so that you and Rand can get right down to work?"

He was touched by the offer. Eva was a Shimizu institution, and she did not offer her time lightly or often. She was one of very few guests who knew her way around the place as well as Jay, who did not need to follow some AI's trail of blinking lights to get where she was going. "I think I've got that covered," he said. "But if they do need more help, I'll know where to come. Thanks, Eva."

She looked dubious. "Who have you got in mind?" Eva had a low opinion of most of the Shimizu's staff Orientators, which Jay shared.

"The new kid. Iowa."

"Seen him a couple of times; don't know him."

"He's a natural. Spaceborn."

That interested her. "Is that good? Will he know what it is they don't know?"

Jay nodded. "He's been dealing with mudfeet all his life, one way or another. The ones here are just richer, that's all. I think he and Colly are really going to hit it off."

"I'll have to meet him. I always wanted to get to know a spaceborn."

Diaghilev cleared his virtual throat. "One minute, Jay."

Jay was still in Deluxe country—the cheapest of the Shimizu's accommodations, the inner-sphere suites with no windows onto space. It was time to jaunt. "I've got to go. Uh... look, keep this absolutely top secret for, oh, at least another fifteen minutes, OK?"

"Twelve, my final offer."

"OK, I'll talk fast." He kissed her wrinkled cheek and pushed off.

"Drop by for a chat before dinner, all right?" she called after him. "Something I want to ask you."

He waved agreement without looking back.

He passed quickly through the rest of the Deluxe Tier to the inmost core, jaunted past his own office without stopping, and reached the executive offices on time. Warned of his arrival by Diaghilev, Tokugawa's own AI had materialized its Personal Executive Assistant persona for him, rather than the Front-Desk Clerk avatar it would have shown to a guest. "Good afternoon, Mr. Sasaki," she said. Her voice

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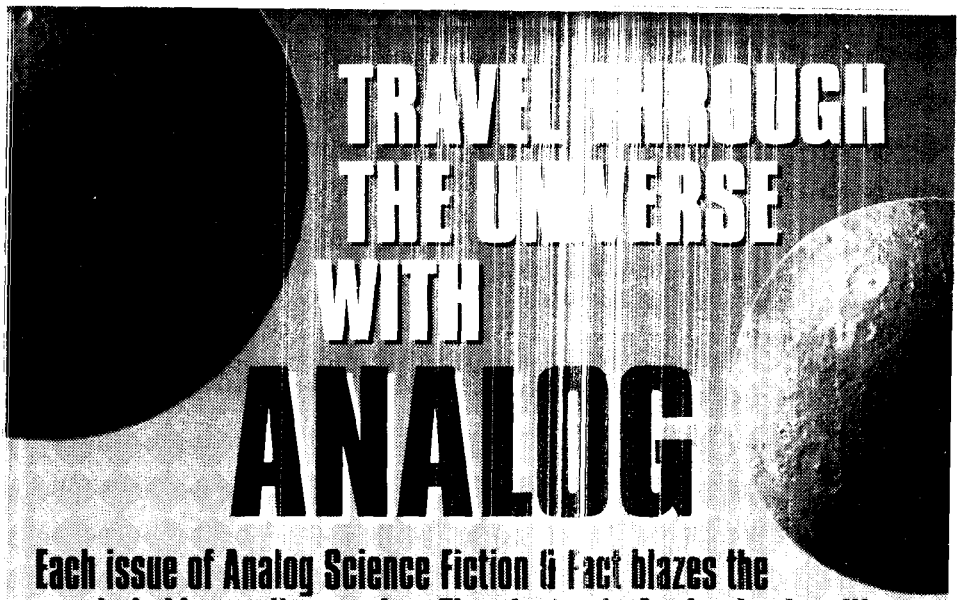

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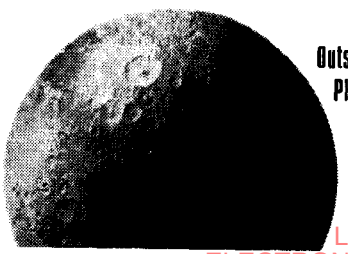

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was oddly flat and nasal, perhaps in an attempt to make her seem real.

"Good afternoon, Ms. Boswell."

"Ms. Tokugawa will see you now." The door to the inner sanctum dilated.

Jay jaunted through it, brushing the doorway with his fingertips to decelerate himself to a stop inside.

Katherine Tokugawa was sitting kukanzen in the center of her spherical office, dressed in black ceremonial robes, her back to him. At the sound of the door hissing shut behind him, she unlaced her fingers, unfolded her legs from lotus, and flexed at the waist, rotating until she faced him. He politely spun until their local verticals matched, and they exchanged a bow. Then they each "took a seat," in the free-fall sense of the term, giving a short puff with their thrusters so that they backed away from each other and velcroed their backs and buttocks to opposing surfaces, Jay maneuvering to avoid sitting on the door he had just come through; they sat more or less simultaneously.

"Well?" she said then, in the slow exhalation of one emerging from profound meditation.

It was all bullshit, of course, and Jay knew it. If she had really been meditating, she'd have velcroed herself to a wall or some other support. A person who sits kukanzen in the center of a room in zero *g*, unsecured, sooner or later ends up bumping against the air-exhaust—and shutting down the airflow only causes a ball of exhaled carbon dioxide to accumulate and smother the meditator. The manager of the Shimizu was—as the job called for—one of those people who prize appearance over content, style over substance, and Rinzai Buddhism was merely part of her admittedly impressive act. To have actually practiced it would have been an inefficient use of time.

But Jay was not about to let his boss know he saw through her. Not when he was about to piss her off. He slowed his breathing, adjusting to her rhythm. "My brother said yes," he told her.

She smiled wearily.

Tokugawa—he dared not let himself think of her as "Kate" while in her presence—was a hundred and sixty centimeters long, and massed forty-six kilos. In free-fall her small size had the effect of making her seem to be a little further away than she actually was. Which made her seem just a little more crisply in focus than other people. She had stabilized her apparent age at forty standard years, with silver streaks in her hair that were in different places each time you met her. Jay had no idea what her real age might be. She was the granddaughter of Yoji Tokugawa, who had succeeded Bryce Carrington as chairman of the board of the original Skyfac consortium back before the turn of the millennium, and her family still controlled a large share of space industry today. She had their "look of eagles," backed by a competence that few Tokugawas actually possessed any more: she *looked* so much like the manager of the finest hotel in human space that her genuine fitness for the job was almost a happy accident.

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Neither attribute particularly impressed Jay, but then, he had to work for her.

"Good," she said quietly. "It was about time for something to go right."

"Troubles, Ms. Tokugawa?" Jay asked, testing the waters to see just how bad a time this was to bring up the matter of the two month escape-clause Rand wanted.

She made a flicking-away gesture. "Not really. Just an infinity of minor nuisances."

"How minor? Is the house still pressurized?"

"For the moment," she replied drily. "No, nothing serious. I've got a major economic summit coming up next month, with so much weight I'm going to have to double security, and—"

"Excuse me, I could have sworn you just said you were going to double security."

"I did."

Jay stared. "There is no such quantity. You can't double infinity. *God* isn't as secure as a Shimizu guest."

She grimaced. "If He had security like those five are going to have, Satan would never have gotten off a speech, much less a coup attempt. Their combined resources are . . ." she paused, and Jay waited, curious to hear what word she would choose. ". . . Impressive," she finished, and he repressed an impulse to lift his eyebrows. Any personal fortune that impressed Katherine Tokugawa staggered Jay. "If they ask me to, I'll have to taste-test their food myself—or anything else they want."

"That does sound like a lot of pressure."

"Special diets, special requirements, protocol headaches—the Muslim needs to know where Mecca is at all times, precisely, and the Chinese wants me to have that Soto Zen roshi flown in from Top Step to do dokusan with him, and as for the American—well, never mind what *she*'ll want—and of course each and every one of them must be honored and coddled and pampered *precisely* as much as the other four, to the tenth decimal, never mind that it's apples and—" She caught herself, glanced down at her meditation robes, and took a long cleansing breath. "Never mind any of it. It's par for the course these days. And not your pidgin. About your brother—any problems I should be aware of?"

Jay's turn to take a deep breath. "One potential glitch . . . but I'll make sure it doesn't express. Don't even give it a thought."

"Fine. What am I not thinking of?"

"He says he wants a two month trial period. He'll finish out Pribhala's season—but if his wife and daughter don't like it up here, he'll quit then."

Her eyes closed momentarily, and the ghost of a frown chased across her brow: those were the only external signs she gave. Those who choose style over substance are compelled to stay with style no matter how tough it gets. But Jay knew she was furious. And here he was, a convenient and fully-qualified target . . . .

"Why couldn't his family have come up with him the last time?" she asked quietly.

"His wife was on deadline and

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couldn't leave her desk for more than a few days," Jay reminded her. "She's a writer. Remember, they thought he had at least two more seasons—two more years—before the board would make a final choice . . . and only a 25 percent chance it'd turn out to be him."

Tokugawa had her hands clasped in the kukanzen *mudra*—but now she was unconsciously twiddling her thumbs. The effect was so ludicrous that he knew she would be even angrier if she became aware of it; he concentrated his gaze on her eyes. "True," she admitted grudgingly. "We are rushing him. His demand is reasonable. But if his wife decides she's a groundhog, the house loses face. Damn Pribhala—this is her fault."

Privately he disagreed. Pribhala could not help being a perpendicular. None of those poor unfortunates could. If anything, the situation was the fault of the Shimizu's board of directors, for not simply picking a shaper. The three-year-rotating-audition scheme had always seemed crackbrained to Jay; something like this had been bound to happen. But his advice had been ignored, and now was not the time to mention it. The blame looked better on Pribhala than it did on him.

"I'd better call in Martin," she said. "I hate speaking to the man, but this is his pidgin. Maybe he can. . . ." Her voice trailed off disconsolately.

Jay empathized completely. Even for a PR man, Evelyn Martin was a weasel; you wanted to bathe after talking with him on the phone. But he *was* gifted at spin control—

A metaphorical lightbulb seemed to appear over Jay's head.

"You're not looking at this right," he said suddenly. "This isn't bad news—it's mitigated good news. All it takes is a little spin control."

"Explain."

"Look, all Martin's press release has to say is that Pribhala has canceled for medical reasons, and that Porter has graciously consented to fill out her term. At the end of two months, *maybe* you have to announce that Porter has dropped out too, and let Choy and Mazurski carry on competing from there—a minor kerfluffle. But most likely his wife and kid will love this place as much as everyone else does—so you announce *then* that he's been given the final position and has accepted. Either way, none of the board's face is lost."

"Your brother would accept that? Not announce that we've picked him as the final winner until he's committed himself? And not announce that at all, ever, if he decides to opt out?"

"Gladly, I think. It gets him out of an impossible situation too." He had a rush of brains to the head. "But you should bump him to the permanent salary right away."

Her thumbs stopped twiddling. "Done. Mr. Cohn!"

Her AI materialized its lawyer-persona between her and Jay, facing both of them. As always, Mr. Cohn reminded Jay of an impossibly-motionless shark. "Yes, ma'am?"

She gave instructions for the amendment of Rand's contract, relying on Cohn's legal software to translate her wishes from conversational

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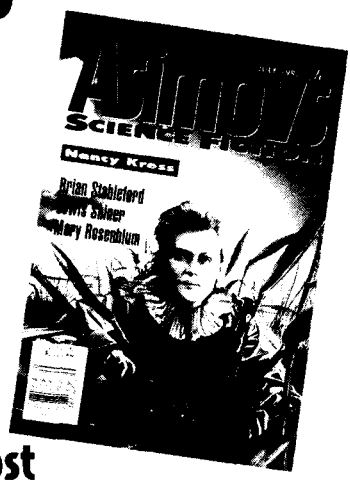

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English into Lawyerese, and spoke her signature. At Jay's suggestion, she had Cohn upload a copy to Diaghilev so that Jay could pass the document on to Rand later that night. Then she dismissed the AI and turned back to Jay. "Sasaki?"

"Yeah?"

"You've earned your air today."

He smiled; the first sincere smile of the day. He felt as if he had just successfully matched orbits by eyeball, without a computer—a terrestrial analogy might be walking a tightrope over an abyss. "Always nice to hear. I'll let you get back to your meditation."

"Thank you," she said. "But first, your reward. *You* get to tell Martin about all this."

He grimaced. "It's true, then: no good deed goes unpunished."

"Except those committed by Stardancers. They seem to be exempt."

"That's an idea," he said. "I'll go out the airlock without a suit."

" 'In space,' " she said, seeming to be quoting something, " 'no one can hear you scream.' Please yourself—but see Martin first."

Jay sighed. "Yes, boss."

He had originally intended to call Eva Hoffman and beg off on the chat she had asked for. But now he needed to tell someone how relieved he was, and how clever he had been in wiggling, at least for the moment, off the spot marked X. As he left Tokugawa's office, he consulted the mental list of people he trusted enough to share news like this, and—Ethan being history now—found only Eva's name. She was not an employee of the house, plugged into that grapevine . . . nor did she fraternize much with the other guests, even the other Permanents. Most of them considered her crazy. She was easy to talk to, and in his opinion she had more character and style than any ten other people he knew. He had often thought that if Eva were, oh, say, sixty years younger, he might have considered turning hetero again for her. Hell, even fifty years younger . . . .

Telling Diaghilev to call ahead and announce him, he left the Core and jaunted back outboard, through both Deluxe Tier (peasant country, at least in Shimizu terms) and UltraDeluxe Tier (the bourgeoisie; governors, national-level executives and so forth), all the way to the Prime Tier, the outer suites with the most cubic and a naked-eye view of space. Eva's digs were in the Prime Plus hemiTier: the one whose view included Earth. She had chosen a suite offset from the center of that section, so that the home planet did not completely dominate the view, a choice Jay approved of since he had made the same one himself. Her door opened for him when he reached it, and her voice bade him enter.

Her suite was lavish and comfortable and hushed. As a long-time resident of Shimizu, he knew the second most expensive thing in it was the hush. The third most expensive thing was the sheer cubic volume, and the air that filled it. Jay was one of the half-dozen hotel staff with enough clout to rate quarters in Prime Plus, and his own suite was a quarter the

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size of this one. Even by the standards of a permanent guest of the Shimizu, Eva was wealthy. Kate Tokugawa would have said that her assets were "substantial," only a step below "impressive."

His eyes found Eva where they expected to, by the room's *most* expensive feature: floating within the three-meter-across bubble window (called an imax for obscure historical reasons), which made the best Prime Tier suites cost twice as much as Deluxe accommodations. As was her custom when at home, she was wearing only wings and fins, sculling them gently and quite unconsciously to hold her position in space against the gentle current of airflow. It was a sight he had seen countless times, and still found striking and moving: a butterfly with a withered body, Rodin's *She Who Was Once The Beautiful Heaulmière* somehow given the wings of a swan by the gods in clumsy compensation for the ruin of her beauty. Nobody looked sixty anymore these days—certainly no one whose real age had three digits—and Jay found Eva's defiant decay paradoxically entrancing. Especially juxtaposed against the wings, modern and high-tech . . . and that absurdly expensive surround-window . . . and the stars beyond, their steady fossil light unthinkably older than Eva could ever hope to be. He wished he had the nerve to use the image in a dance, but Eva never missed a premiere. She had been born back in the days when nudity was strongly taboo—and while she'd obviously come into the twenty-first century, he had noted that she was never nude save when closeted with intimates.

Oddly, the thought had never once occurred to him that he would probably be free to use the image as he pleased one day, all too soon—that it could not be long before Eva died. If it had, the thought would have saddened him . . . but there was something about Eva that kept him from having it.

He politely removed his own clothing and let bee-sized tugbots take charge of each garment. He did not bother to remove his own wrist and ankle thrusters. Eva didn't object to their emissions, she just didn't care to use thrusters herself if she didn't have to; and Jay felt far more naked without them than he did without clothes. Nonetheless he allowed other tugbots to give him his own set of wings and fins, slid them on over his thrusters, and used them to join his hostess at the window. He was, if anything, more skillful at air-swimming than she was; he simply preferred the superior kinetic and kinesthetic versatility thrusters offered.

The jaunt to her side was uncomplicated: the room seemed as starkly furnished as a Zen master's cell, all its fabulous conveniences invisible until they were needed. That was its fourth most expensive feature.

She rode the turbulence of his arrival expertly, and helped him steady himself into station beside her, just far enough away to allow them both wing room, all without taking her gaze from the window. She had chosen a local vertical that put Earth in the lower left quadrant of the win-

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dow. Perhaps a fifth of the planet was sunlit, a lens-shaped slice of Old Home. The rest of the view was of eternity.

They shared it in silence for perhaps a minute.

"Drink with me, Jay," she said then.

He didn't care much for alcohol as a rule; he hated what it did to his kinesthetic sense. But he did not hesitate. "Name your poison." He told himself that it would anesthetize him against having to talk with Martin later.

"Jeeves," she called, and her AI shimmered into view, oriented to her local vertical and seeming to be standing on air.

"Yes, madam?"

"The good stuff."

One holographic eyebrow rose half a centimeter. "Very good, madam."

Both of Jay's eyebrows rose at least that much. This was not going to be a casual conversation. He stopped rehearsing his account of how clever he had been in Kate's office.

Chapter 5

Jeeves moved away without moving his legs, as if he were under gravity and his feet were on wheels, and ceased to exist when he left the human's peripheral vision. Tugbots delivered an amber bottle, two bulbs, and a spherical table to the spot where he had vanished. As they arrived, Jeeves reformed and picked them all out of the air expertly as he "rolled" back into view. He placed the table between Eva and Jay and told it to stay there, placed a bulb against either side of its Velcro surface and the bottle in the center facing them, so that the table looked like a stylized Pinocchio, and shimmied back a pace. Eva thanked and dismissed him; once again he glided out of view before dissolving.

"I never thought I'd see that again," Jay said respectfully.

She nodded. The bottle was an ancient quart of Black Bush, about three-quarters full. It was something like a century old, and its contents were twelve years older than that, a blend of whiskey so fine that at the time of bottling it could not legally be exported from Ireland. Its source was the oldest distillery on Earth, whose charter-to-distill had been granted in 1608. There probably was not another bottle like it left anywhere in the Solar System. Jay was the only person in the Shimizu besides herself who had ever seen it; they had shared a dram the night Ethan's goodbye message arrived from Terra.

He steadied her while she poured, a process of pulling the bottle away while chasing it with the open end of the bulb, then pinching off the flow with one thumb while she sealed the bulb with the other. She did it better than the Chief Sommelier in the Hall of Lucullus, losing not a drop of the precious whiskey, fiercely proud of her ability to control her aged fingers. Jay accepted his bulb with thanks. He brought it up past his nose in a slow gentle curve, squeezing slightly so that the nipple dilated and the bouquet came to him. When she had filled her own bulb and replaced the bottle, he raised his in salute, and they drank.

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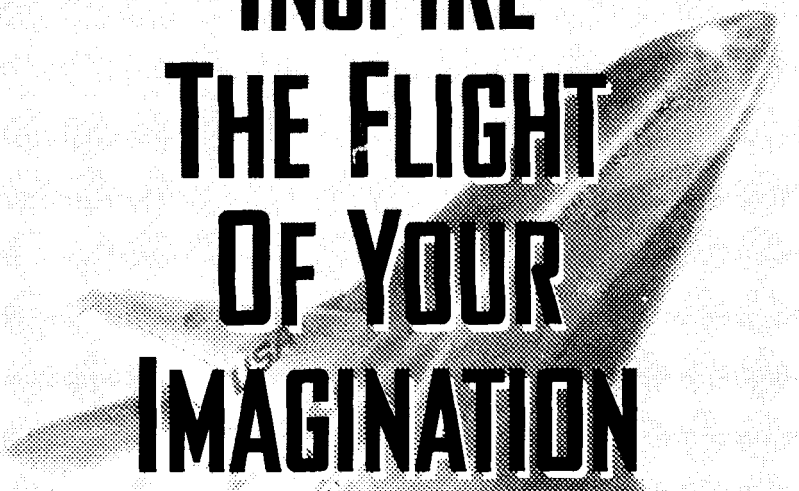

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The silence stretched on.

"Silly," she said at last. "I'll never get over how silly it is."

"What's that?" he asked.

"You could blindfold me, tug me around the hotel enough to confuse me, lead me into any room in the place and dock me in front of its window . . . take off the blindfold and *defy* me, without looking away from the window, to tell you which Tier I was in. There is no way to tell a real window from a fake one without instruments. And yet this thing is worth every yen it costs me. About the gross annual product of a medium town . . . and I'd pay three times as much if I had to. Why?"

He seemed to know a rhetorical question when he heard it; he made no reply.

"Why are they so goddam *happy,* Jay?" she asked then.

"Who?"

She gestured at the Earth. "Them." Her gesture widened to take in orbital space, then widened further. "All of them. Our species. The human race in this year of Our Lord 2064. I think I know why the Stardancers are happy—but why people, too?"

"I'm not sure exactly what you mean."

"Exactly. That's what I mean." She squeezed more whiskey into her mouth, rolled it around and swallowed. God, she missed her original taste buds sometimes. "They probably don't even seem all that happy to you, do they?"

"I never really thought about—"

"Trust me. I've been watching the human race a long time. At this point we ought to be more traumatized than ever before in our history. The Curve of Change is almost vertical by now, like a goosing finger—you do know about the Curve?"

"Sure."

Of course he did—as a dry old chestnut from a history lesson. For millennia the curve of human social and technological progress had trended upward, but so slowly as to be almost imperceptible . . . then all at once it had passed some critical threshold and begun climbing sharply. Ever *more* sharply, the rate of increase itself accelerating steadily, until the race lurched from covered wagons to spaceships, from kingdoms and fiefs to planetary government, from chronic global poverty to staggering near-universal wealth, in a single century. Remarkable. Inexplicable. Where would it all end? And so on.

But Eva had been born into the middle of that century. Just about the time it was beginning to dawn on humanity just how oddly the Curve was behaving. And humanity's general response had been to run a high fever . . . .

"I don't mean trivial things, like conquering cancer. I mean substantive changes in the map of reality. When I was a girl, the phrase 'New World' still meant North America. Now it means Mars. The Old World—that one right there—is just about unrecognizable, if you look at it any closer than this. The population has more than doubled since I was born, and look at that planet: it's still green. All the most fundamental

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axioms of politics, of economics, of industry, have all come apart since the turn of the millennium, obsoleted by new technology. We seem to have a handle on pollution, for God's sake! After half a century of holding my breath, I'm prepared to admit that it looks like we really may have outgrown war. Thanks to nanotechnology, I'm even getting ready to concede that a day may even come when we'll have outgrown *money* . . . a day when no one alive has to work to earn her living, when nobody will remember—or care—what a 'salary' was, or why people gave up a third of their lives to get one."

"And you wonder why people are happy?"

"*Yes!* Two axioms I cling to are that change is painful and that humans react poorly to pain. Change that radical and fundamental *has* to hurt, to confuse, to anger. For the first seventy years of my life, I watched my species grow ever more neurotic, more sullen, more despairing, more bitter. You know what I'm talking about."

"Well, I've read about it, seen records, old flatscreens and so forth—"

"They don't convey it. Believe what I'm about to tell you: when I was forty-five years old, 95 percent of the intelligent thoughtful university-educated people I knew believed as an article of faith that technology and change were dooming the planet, and that some of us would live to see the Last Days. Just about every one of them had a different candidate for what specifically was going to get us. Nuclear Winter was the big one until the Soviet Union went broke. Within about fifteen minutes, fifty other Ends Of Everything had moved in to replace it: global-warming, ice-age, the ozone layer, overpopulation, deforestation, dwindling resources, pollution, energy-shortage—I can't even remember them all any more. Pestilence, famine and plague were evergreen favorites, and you could always find someone who was putting his money on a runaway comet. If you had a taste for the exotic, you could be terrified of flying saucers and empires of alien cattle-mutilators. But just about every adult I knew clutched *some* form of Ultimate Paranoia to his or her breast. Almost without exception they chose to believe that the End of All Meaning was just over the horizon. If you didn't know *that*, you were too stupid or naive to be worth talking to.

"I'm overstating it slightly, because the sample I'm talking about consisted almost exclusively of affluent North Americans. But only slightly. In 1991 a major poll asked average Americans if they would like to live five hundred years, assuming that could be accomplished cheaply and comfortably. *Only half of them said yes.* Fully half of that society was looking forward to dying."

Jay frowned and took a drink of his whiskey, forgetting to savor it. "How weird it must have been. To live in an age when the best and brightest worshipped Henny Penny. When the crew of Starship Earth, wealthy beyond the wildest dreams of their ancestors, were on the verge of mutinous panic . . . ."

She nodded. "And then right at the

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turn of the millennium, just as the worst thing possible happened and the wildest of all those paranoid fantasies *came true*... just as actual aliens appeared in the sky, changed our destiny for us in great and incomprehensible ways, and vanished again before we could ask them any questions... everybody calmed down. The Curve kept on rising faster than ever, and somehow everybody on Earth seemed to heave a great sigh, and kick back, and *relax*. Not right away, no, not all at once—but the damn planet has been getting slowly and steadily *saner* for over sixty years now. And it's driving me crazy!"

He swirled whiskey around in his bulb, stared through and past the oscillating golden liquid to the planet they both had left forever. "It doesn't seem all that sane to me," he said.

"No, I'm sure it doesn't, to someone your age," she agreed. "It *isn't* all that sane. But it's sane-*er*. Do you know that at one time the United States had 10 percent of its population imprisoned? Justly? As the best solution they could devise to problems they didn't begin to understand? Every year the papers told you the crime rate was rising. It's been falling for over twenty years, now... and somehow that never makes the headlines. The media just aren't geared up to report good news. You have to dig that out for yourself."

"I think it has to do with the curve you were talking about," he said.

"What do you mean?"

"The latest spike in the curve. The Nanotechnological Revolution. Molecular-scale technology. It's qualitatively different from the Industrial Revolution or the Silicon Revolution or any of those. For once we got a new technology that cleans up its own wastes, doesn't despoil anything we cherish, and produces so much new wealth nobody could steal it all. Our first *healing* revolution. Take the revolution you grew up with, Eva: nuclear fission. They told everyone it would produce power too cheap to meter. Then it turned out the plants were big kludges, and nobody's power-bill seemed to go down a dollar. No wonder they stopped trusting people in lab coats. But this generation got a technology that delivered on its promises." He sipped his drink again, appreciating it this time. "And come to think of it, that was mostly thanks to the Stardancers. Without them and their Safe Lab, we'd still be skirting the edges of nanotechnology, too scared of someone getting a monopoly on it, or scared of the wrong little nanoassembler getting loose and turning all the iron to peanut butter or something."

"Or we might have destroyed the planet in a war for possession of the new technology," she agreed. "Instead we've got a U.N. that means something—and a repaired ozone layer and a healthy ecosystem and nonpolluting industry and a world so fat and rich it hasn't had even a serious local war for thirty years."

"The Stardancers kept us honest," he said. "Thanks to the Fireflies, we had a precious resource: people we could trust to be above human greed and avarice, people with nothing to gain, people who could not be bribed

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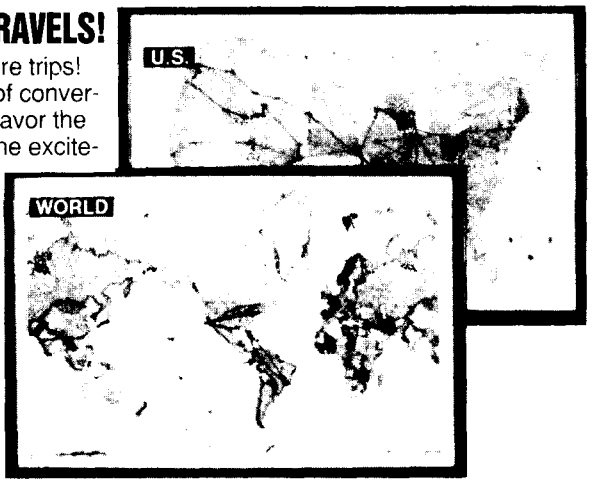

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or coerced."

"Bodhisattvas," she said.

"If you like," he said. "Fair Witnesses, anyway."

"No wonder there used to be terrorists trying to kill them. A fair witness can be infuriating."

"Yeah, maybe—but the last serious attempt was about the time I was born. Even a fanatic reactionary can see they're just too valuable to the race now: they can live full-time in space with no life support, and space is the only safe place to develop little artificial viruses, the only sensible place to collect solar power. Humanity got lucky. We got just what we needed, just when we needed it."

"Luck, hell," she said. "You just said it yourself. Luck had nothing to do with it. It was those damned Fireflies: they saved our bacon for us, brought us the Moon-full of Symbiote that makes a human a Stardancer, and *gave* it to us, for free. I could kill them for that!"

She could see that she had shocked him. She waited, to see how he would handle it. "This is what you really wanted to talk about," he said finally.

She smiled. "Pour for us, please, Jeeves."

When the AI had refreshed their bulbs, she turned to face him directly. He copied her, and they joined a hand to steady themselves in the new attitude. She held on.

"Jay," she said, "I'm old. I was old enough to vote when the first tourist littered the Moon. I was spending a fortune on cosmetic camouflage the year the Fireflies showed up and Shara Drummond danced the Stardance for them. I've had a five-cent Coca Cola, and watched the first television set on my block. Flatscreen, monochrome, no-fi monaural. I've played 78 RPM phonograph records on a hand-cranked Victrola. I've buried three husbands, three children and two grandchildren. One of my great-grandchildren in Canada is dying, and I have to keep asking Jeeves her name. Jeeves, what is my dying great-grandchild's name?"

"Charlotte, madam," Jeeves murmured from somewhere nearby.

"I have been a success in three professions," she went on, "and a failure in two. It's not that most of my life is behind me. *All* of my life is behind me, receding. I always said I was going to check out when and if my clock showed three figures . . . and I came here to the Shimizu for that purpose. I stopped controlling my cosmetic age the day I moved into this suite, as a sign that I was withdrawing from human affairs. I've been saying goodbye for the last sixteen years. You know most of this."

He nodded and sipped Irish whiskey, still holding her hand.

"Haven't you ever wondered what's taking me so long?"

He shook his head. "Not once. I figure saying goodbye to life could take me, oh, *seventeen* years, easy."

"You'll find out," she said. "Old age is not for sissies. I had all my goodbyes said years ago."

"All right," he said agreeably. "I'll play Mister Interlocutor. Why *are* you still using up air, Ms. Hoffman?"

"Sheer annoyance," she said. "I'd always expected to live to see the

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world end. I planned to watch humanity die of its own stupidity and meanness, and chortle at the irony of it all. I expected to enjoy it immensely."

"I can understand that," he said slowly.

"Long before I came up here, I'd admitted to myself that it just isn't going to happen any time soon. OK: I didn't insist on doom . . . as so many of my contemporaries had. I would have settled for watching us come through in the clutch, reach deep inside ourselves and pull out the best of us and *solve* our damned problems." She glanced down at her bulb, found too much whiskey there and corrected the problem. "What I wasn't prepared for was to have little red Fireflies drop in and fix things *for* us . . . and then scamper off to wherever the hell they came from without telling us *why!*"

She looked into his eyes for understanding, and did not find it. He was too young for questions like this to be troubling in any way but an abstract sense. And he had grown up in a world where telepathic Stardancers—and the mysterious alien Fireflies who had appeared out of nowhere, created the Stardancers and their collective Starmind, and then vanished back into deep space—were prosaic history, something that had happened sixteen years before he was born. She saw him try to understand, and fail.

She broke eye contact and sculled around to face the window and the world again. "Anyway, it's come to me in the last few days that what I've been doing . . . what I've been waiting for . . . has been for the damned Fireflies to come back from wherever they went and tell us what's going on. Or for me to cleverly deduce it for myself. The most important philosophical question the human race has faced since the aliens dropped in and out again is 'What the hell was *that?*' In sixty-four years we haven't made a dent in it.

"Realizing that has forced me to face the fact that I'm wasting my time. If nobody else can figure it out, I probably can't either. Available evidence indicates the Fireflies drop by once every couple of thousand years at best. I can't wait that long. And this steady diet of unearned good news lately has just got me baffled."

"Are you sure it's unearned?" he said. "Stardancers start as human beings, however different they may become after Symbiosis. The scientific name for them is *Homo caelestis.* Humanity birthed them: the Fireflies were just midwives."

"Stardancers do not suffer from fear or hunger or poverty or lust or loneliness," Eva said. "Thanks to their Symbiote, they're immortal, effectively invulnerable, and perpetually loved. As far as I'm concerned, that means they're not human any more. And if things keep going the way they are, it's conceivable that one day nobody on Earth may be hungry or cold or oppressed. If that day comes, by my lights there won't *be* any human beings any more."

"So you want to leave while things are still miserable," he said.

She frowned at her drink.

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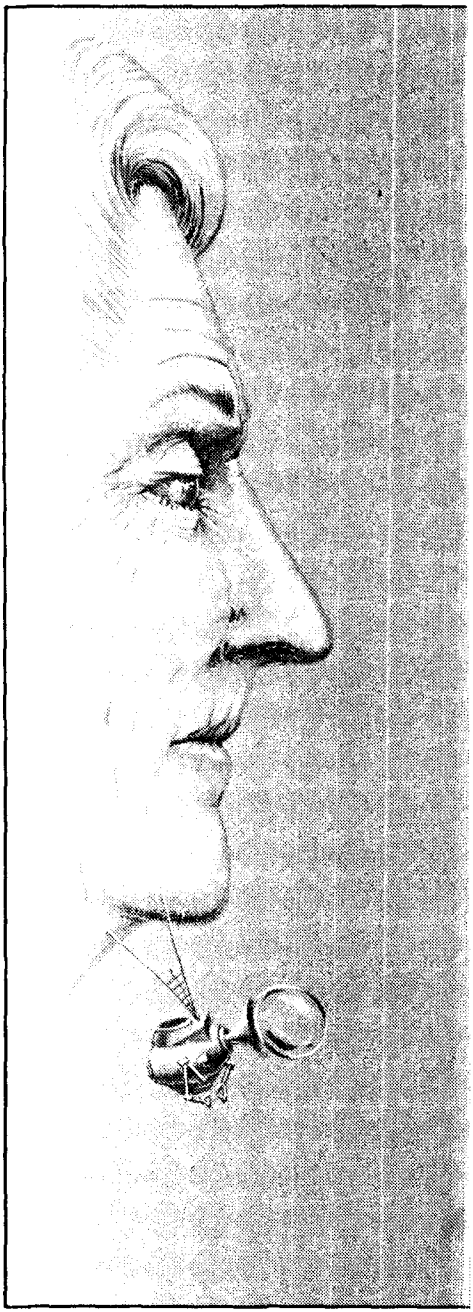
"No," she said. "That's my point. Everybody's happy now. I personally think that in time the hangover will arrive, and people will find out that even nanotechnology has hidden costs. No matter how many miracles we come up with, I believe there are *always* limits to growth. I have a friend named Ling who says he can prove it—I can't follow his math, but it sounds convincing. But meanwhile there is peace on the world; maybe it's only temporary, but nobody can know that yet. So maybe this is a *good* time to leave, and I should stop dragging my feet."

He kept his face expressionless. "How do you plan to do it?"

His very neutrality cued her that he was angry. It startled her. She precessed to face him again. "Is that relevant?"

"It's closer than anything that's been said since I jaunted in here," he said. "Let's cut through all the bullshit about Stardancers and Fireflies and how happy the world is today. You have obviously decided to check out. For some reason you think I need to know that in advance. That means you have some role in mind for me. I'm curious to know what it is. Do you want me to stand by with the ceremonial sword in case you lose your nerve? Am I supposed to talk you out of it? Or just be your witness and hold your hand? Angel's advocate, enabler, or audience—I can go any way you like, Eva, I'm your friend and I'll try to give you whatever you need of me, but you've got to tell me the steps."

She let go of her drink and reached



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toward him with her withered hands. He abandoned his own drink and took them in his own.

"In a month," she said, "Reb Hawkins will be coming to the Shimizu. I want to talk with him one more time. Immediately after that I plan to go out the airlock." She gestured toward the window with her chin. "Out there. When I'm ready, my p-suit will kill me, painlessly and not abruptly. I want to die in space. As I die, I would like to watch you dance . . . if you're willing."

He was speechless. He tried to free his hands, and she would not let him. He tried to tear his gaze from hers, and she would not allow that either. "Why me?" he said finally.

"Dance is the only thing humans do that's *only* beautiful," she said. "It's the only thing we do that speaks even to Fireflies, as far as we can tell. I want to die watching a human being dance. A human, not a Stardancer. You're the best dancer I know. And you're my friend. I thought about not putting this on you until the last minute . . . but I thought you might want some time to choreograph your dance. I know how busy you'll be once your brother arrives."

Globules of salt water began to grow from his eyes. Despite sixteen years in free-fall, she still found the sight of zero-*g* tears simultaneously hilarious and moving. And contagious. He shook his head, and the droplets flew away. She blinked back her own, and waited.

At last, with difficulty, he smiled. "I am honored, Eva," he said. He released her hands, plucked his bulb

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out of the air, and raised his arm in a toast. She reclaimed her own, and they emptied them together. She did not hesitate, spun and threw her bulb as hard as she could, directly at that absurdly expensive window. It shattered musically.

She had startled him. A cannon couldn't have broken that window—but still, what a gesture! He was game, though: his own bulb burst only a second or two after hers. When they had recovered from their throws, he bowed to her, a Buddhist *gassho* she suspected he must have learned from his grandmother. She returned it gravely. "Thank you," she said.

There was nothing left to say. Or too much. After they had watched the tugbots chase and disassemble glass shards for a few moments, he cleared his throat and said, "I've got to see Ev Martin before dinner."

She grinned. "Another argument for suicide. You're right, you wouldn't want to talk to him on a full stomach."

"Not even on a stomach full of hundred-year-old whiskey," he agreed. "But it'll help. Thanks for it."

She made a mental note to leave him the balance of the bottle in her will.

He paused at the door. "Eva?"

"Yes," she said without turning.

"Is it all right if I spend the next month trying to get you to change your mind?"

"Yes," she said without turning. "But don't be attached to succeeding, Jay. I've been thinking about this a long time."

After awhile she heard the door close and seal.

Chapter 6

Toronto, Ontario
4 December 2064

There is no such thing as a slight flaw in a dance floor.

And all floors have flaws. Anyone but a dancer would probably call them slight: certainly the manufacturers do. Nonetheless, each floor has its own invisible peculiarities, lurking in wait for dancers' feet. Even the marley floor of Toronto's famous Drummond Theatre. The company had gone through two complete rehearsals, undress and dress, without a hitch; it was in the final onstage warm-up class, a scant hour before curtain, that John DeMarco, who had been dreaming of and working toward this night for all his professional life, found the flaw with his name on it. It broke his ankle.

At any other time it would have been a nuisance. The actual repair could be accomplished in less than ten minutes at the nearest hospital. After two hours of datawork and waiting in the emergency room. And once fixed, you'd be hopping around good as new . . . in a matter of mere hours . . . .

The ugly sound had riveted the attention of all. It took only minutes to establish that the nearest hospital was half an hour away in the best of times, and that everyone in the company seemed to have run out of painblock at once. So had John, of course. Dancers started to drift away to call hospitals and search dressing rooms and

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find the driver; the AD, watching her company scattering to the four winds an hour before curtain, bellowed them into stasis and bent over John's recumbent form. "Is there any hope at all?" she asked.

It was clearly a break, not just a sprain. John shook his head, and started to apologize.

She waved it away. "Then you'll have to live with it for awhile. I can't spare anyone here: I have to recast the whole performance in forty-five minutes, and everyone I can see I *need*. We'll put you in dressing room two. Jacques! Harry!"

The pain was exquisite, almost nauseating. "No! Wait! Put me in the audience. If I can't be in it, I'm gonna see the runthrough."

She nodded to Harry and Jacques. "Do it."

Harry, the stage manager, gave him a jacket to put over his warmup clothes, promised to try and find him some painblock and a ride as soon as possible, and left him front-row center. Not an ideal seat, but convenient. One of the dancers who could be spared momentarily brought him an improvised pack of ice from the concession in the lobby. He concentrated on the frenzied activity onstage to distract himself from his pain.

Shortly after he decided Anna was fucking the whole thing up, he noticed that the pain was gone. Utterly.

He yelped, in astonishment and something like fright. Anna glared at him from the stage. "Harry, take him backstage—"

"No," he said. "Sorry. I'm fine; won't happen again."

She went back to her work. He bent and looked at his ankle. No question, that was a broken ankle, all right. The swelling was already so advanced that he knew it was badly broken. Now why in hell didn't it hurt?

The swelling began to visibly reduce.

He yelped again. Anna turned and came to the edge of the stage. "John, I'm sorry, but—"

"Look at my foot!"

She blinked.

"God dammit, come down here and look at my fucking foot!"

The dancers followed her. They gathered around and watched his ankle heal itself. After a few murmurs and gasps, no one said a word. In minutes, the ankle looked just like its mate. John flexed it slowly, listening for grating sounds, and then extended it with the same care. Then he circled it, one way and then the other, and started to laugh. Soon everyone was laughing, even Anna. He got to his feet, took a few cautious steps—then took a running start and sprang up on stage. He did a combination on his way to his place for the first piece. "Come on, boss," he said, still laughing. "Time's a-wastin'!" It was one of her catch-phrases; the company dissolved into hysterics.

Anna let that go on for a good five seconds. From then on they were so busy that it wasn't until midway through the triumphant fourth curtain call that John had time to wonder about it all.

He never did figure it out. He had to be told. But he didn't mind.

* * *

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Chapter 7

Logan Aerospaceport
Boston, Massachusetts
5 December 2064

Rhea felt as if she were on a conveyor belt, sliding even closer toward the butcher's blade.

Logan Aerospaceport was used to celebrity press conferences; a soundproof room had been found for Rand, Rhea, Colly and the cronkites and riveras representing the planetary, national, and local-birthplace media pools. Cambots swarmed like blackflies, recording the scene from at least eight directions. Once in a long while, one of them would decide the ambient light was insufficient, and turn into a white firefly for a moment or two.

Tough new laws had finally succeeded in taming the media: all four cronkites, and even the riveras, were scrupulously polite. Nonetheless they managed to annoy Rhea—by putting 70 percent of their questions to Rand. In the half-dozen previous press conferences they'd had together, the percentages had usually been reversed. It embarrassed her to be annoyed by that, but she couldn't help it. At least she was able to keep him from noticing... though she wasn't so sure about the cambots.

Colly lapped it up. And put on a performance that would have made a child holostar blush. That annoyed Rhea, too.

Which made her ask herself why she was so irritable. She realized what bothered her most of all was how much Rand was enjoying the attention and flattery. It scared her. This was going to be a hard thing to undo. It was feeling more and more like a done deal—and she still hadn't given her agreement to it. Rand knew that, but he wasn't acting like it. Oh, he told the reporters—and the world beyond them—the assignment was only temporary, just completing Pribhala's season: the story he'd worked out with Jay and that horrible-sounding Martin person. But when he said it, she heard in his voice the quiet certainty that the permanent job was his. She wasn't sure if the cambots were hearing that too, or if she was projecting it.

She felt disconnected, surreal, moving against a tide of invisible molasses. *This is a hell of a way to spend my last hour on Earth*, she decided. "Time to go, darling," she said helpfully, as Rand finished a reply.

"Just one more," the flaky-looking rivera from the planetary pool said. "Do you have any comment on the breaking story about outbreaks of rogue assemblers?"

Rand looked startled. "I'm sorry, I've been too busy packing to monitor news. Nanoassemblers, you mean?"

The rivera nodded. "There seems to be growing evidence over the last few days of random instances of... well, of anarchist nanotechnology, all around the globe. Spontaneous healings, spontaneous slum regenerations—sort of little miracles. There's no telling how many, since the tendency is to underreport miracles. Some say there may be some sort of... well...."

"A conspiracy of rapturists?" Rhea

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said, thinking of an old story idea she had never gotten around to developing.

"Rapturists?" the woman from the New England pool pounced.

"The backwards of a terrorist," Rhea said. "But what has this got to do with us?"

The flakey one tried not to look like he knew he was stretching for a tie-in hook. "Well, you're going to space, where nanotechnology comes from. Are you, I don't know, at all afraid some . . . uh, 'rapturist' might decide to put laughing gas in your p-suit tanks?"

To everyone's surprise, it was Colly who spoke up. "There hasn't been one of those stories in space so far," she said.

They all stared.

"It's true," she insisted. "Not one. I watch the news. Anyway, they haven't hurt anybody, have they?"

No one replied.

"Maybe not yet," Rand said. "But anarchy can get pretty scary even when it means well, honey. Maybe especially when it means well." He turned to the cronkite. "But no, we're not worried at all. Everybody knows you're safer in space than you are on Earth: look at the stats. We really have to go now. Thank you all—"

On the flight up, Rhea tuned her seatback screen to a news channel, in time to hear herself ask, ". . . A conspiracy of rapturists?" and then, in response to the rivera's prompting, define the term. A few moments later, Colly and Rand's exchange was quoted too.

The piece in which the soundbite was featured might well have been titled, "Nanotechnology—Threat or Menace?" It was about three times as long as the item she managed to find later on an arts channel, about Rand's return to the Shimizu.

She wanted the flight to be miserable. It was idyllic. No dropsickness in her family—none on the whole plane. No emergencies; minimal, gentle maneuvering; a perfect hop. Superb, pleasant service from human and robot alike. Even the food was excellent: real microwave cooking rather than flashpak. The Shimizu did not permit clients to arrive unhappy, whether they wanted to be or not. The hardest part of the flight was keeping Colly's seatbelt buckled once the gravity went away.

The approach was spectacular. Shimizu looked like God's Christmas ornament, a vast gleaming globe. Its exterior was fractalized for maximum radiating surface, so it sparkled in the sunlight like a vast ball of crinkled aluminum foil. It was girdled by an equator of huge cooling and power-collecting vanes, brilliant silver on one side and space black on the other, that slowly rotated independently as the relative position of the Sun changed. A thousand points of light—people's windows!—added to the illumination, randomly distributed, going on or off as tenants entered or left their rooms.

The plane crept up on the hotel sideways, spinning slowly around its own axis to distribute the Sun's heat, so there were no bad seats. Every time you decided you were there

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now, the damned thing got a little bigger; it seemed planet-sized by the time they actually reached the spaceport at the "north pole."

After a textbook docking, all four doors opened the instant the seatbelt light went out, so that passengers need not stand in line to debark; customs formalities occurred electronically without any of them noticing. The dock itself was beautiful and impressive, its layout and decor operating somehow on the subconscious to make you feel you were home.

Then Rand muttered, "Oh no—*that* asshole."

A large spider monkey with a head like a red sea anemone sprang at them out of nowhere. At the last possible moment he braked to a stop with smelly, poorly-tuned thrusters and flung his arms around Colly. She looked wildly around to Rhea, her eyes asking permission to be terrified.

"I could kiss you," the apparition said, and did so, on the forehead. Colly decided she didn't need permission; the man said "Eek" and let her go and clutched his groin.

"Nice shot, dear," Rhea said, and interposed herself between them before Rand could. She was pleased to find that free-fall reflexes came back quickly to her; she still remembered how to jaunt. "Who or what are you?" she asked him.

He forgot his aching testicles. "The guy who could cheerfully strangle you, Ms. Pash-o," he said cheerfully. "What ever *possessed* you to give them a bite like that, for God's sake? You blew *my* whole story right off the Net with that Rapturist line, lady. Who asked you to improvise? If it hadn't been for this little genius here," he said, pointing to Colly, "it could have been a disaster." Forgetting that she had just kicked him, he reached out and tried to pat her head. "You just keep following your mama around, kid, and every time you see her open her mouth to a sniffer, you talk instead."

Colly ducked until he gave up. "Rhea and Colly," Rand said through clenched teeth, "this is Evelyn Martin, Shimizu's publicity chief."

"And people still come here?" Rhea asked. The man was strikingly ugly. His head looked like a large red Brillo pad with bat-ears and pop-eyes. She had not met him on her previous visit, but Rand had assured her Martin was an excrescence; she decided he had understated the case.

Martin didn't seem to hear. "It's OK for you to talk like that now; I'll dub the audio later, give us all beautiful lines for the release. But I've got the top three cronkites in space waiting nearby to do the personal bit, so pee if you have to and we'll—"

Jay arrived. "Rand and his family will be happy to meet with them later this evening," he said firmly, and embraced his brother. "Sorry, I'm late, bro."

Martin continued to talk rapidly while Jay greeted Rhea and Colly in turn, but they all ignored him. "Twenty-one hundred, Ev," Jay said as he led them from the hall. "They'll wait. Nobody ever turned down a free dinner at the Shimizu. Least of all a cronkite." Martin watched speech-

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lessly as their luggage emerged from the plane and began to follow them.

Rhea had known Jay since her courtship with his half-brother over a decade ago, had chatted with him for dozens of hours on the phone since. But since Jay had made the permanent move to space, around the time she and Rand got married, she had only been in his physical presence once, briefly, during Rand's previous residency. In one sense she knew him well already. But to know if you really *like* someone, you have to smell them. As they all relaxed over drinks in their suite—Rhea's new home! —she found herself remembering how much she really liked Jay.

During a visit to the bathroom she took the occasion to summon Diaghilev, Jay's AI, and ask if there had been any recent news of Ethan. "Ethan who, Ms. Paixao?" was the reply, which was all the answer she needed. The relationship was irreparable. A shame; Rhea had liked Ethan, at least over the phone. "Is Jay seeing anyone?"

There was an imperceptible hesitation while Diaghilev made sure she was cleared for that information. "No, ma'am. He dates occasionally, but has not dated anyone twice." She made a mental note to keep an eye open for a nice young man for Jay, and rejoined the others.

The suite was considerably nicer than the one she'd had on her last short visit. It took her a while to note, and a little longer to believe, that the window was real. Earth was centered in the frame, the terminator just reaching what looked like a major blizzard over the northwest coast of North America. This was one of the more expensive suites in the hotel. She hunted for flaws, and cheered up a little when she noticed the furniture was all permanent. Excellent, and fully programmable, but it didn't go away when you were done with it.

But everything else she could see was state of the art or better.

She told herself sourly that the hotel had given them this suite to soften her up—that once Rand signed on for good, they'd be moved to somewhere inboard with the rest of the peons.

It was Jay who snapped her out of her gloomy mood, by asking her about her work. She thought of the story about Mr. Hansen and his beloved nun, but did not bring it up, speaking instead of the novel she had been struggling with for nearly a year now. Jay listened well, widening eyes at the right spots, making little murmurs of agreement, asked insightful questions with great diffidence. Several of the questions made knowledgable reference to her earlier works. He was either as much of a fan as he claimed to be, or a gifted actor. Either was gratifying.

Colly jaunted around the room like an old-fashioned maid robot, inspecting everything and trying out acrobatic maneuvers with both her wings and her child-strength thrusters, having the time of her life. Every few minutes she found something that made her giggle and call Rhea or Rand to look! or come see! Rhea let her roam unchecked, knowing she would tire herself out and nap

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soundly soon. They'd all had to get up before dawn to make the flight, and it was now nearly six P.M. Shimizu time. Besides, the suite was safe for kids. It was probably safe enough for a blind hemophiliac epileptic.

One of Rand's early songs, "Blues in the Dark," was playing in the background. It was relatively obscure, but one of her personal favorites, since it was about her and Rand's courtship. Jay had selected it when they came in; either he had remembered some casual reference she'd made in a phone chat, or they shared similar tastes. Either way, it helped her warm to him.

She had to admit, it did feel good to be in free-fall again. She had forgotten how restful it was, how reminiscent of childhood fantasies of being able to fly, like the Little Lame Prince. The drugs had controlled the stuffy-head feeling this time, and her stomach felt fine. Rand had already inserted his personal wafer into a terminal in the suite: Maxwell Perkins, her own personal AI avatar, was again at her beck and call, moved from home into new quarters in the Shimizu's memory cores, as was Rand's version, Salieri—while their original copy still maintained the house back in Provincetown. (Also present, and presently in use, was the persona by which Colly addressed it: a large rabbit named Harvey.) Before long Rhea found herself thinking that this wasn't the worst possible place in the world . . . and then reminded herself sharply that it wasn't *in* the world. Not the same one P-town was. She glanced out the window at the distant Earth and failed to locate New England.

Look on the bright side. Your husband might fail spectacularly. You might get a terrific divorce settlement. You might even convince your daughter to come back to Earth with you. The damned hotel could get hit by a runaway planet. Some rapturist might put laughing gas in your air-tank. The future holds infinite possibility.

If Jay was scheming to convert her, his next move was below the belt—literally. He led them all to dinner at the Hall of Lucullus. Not the Grand Dining Room, which peasants like governors and popstars had to make do with, where Rhea had dined on her last visit, but the Lucullus, the most famous oasis in human space. Rhea had dined well in her time, but this was something out of the realm of her experience. They did not turn the cherries into beans for her dessert coffee until she had named the blend she preferred—then roasted them before her eyes . . . and under her nose. The coffee waiter—there was a separate, live coffee waiter—announced proudly as he was pulverizing them (pausing every few seconds so as not to overheat them prematurely) that these cherries had seen the Sun rise from a tree on the island of Sulawezi that very morning. When she had tasted the result, she believed him.

The meal preceding had been so perfect that Rhea took the coffee almost in stride, which mildly shocked her. Lucius Licinius Lucullus, dead over two millennia, would have been

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proud of what was being done in his name. She was halfway through her bulb before she realized how *many* live human beings had been waiting on them hand and foot throughout dinner, with only the maitre d', wine steward and coffee waiter ever coming to her conscious attention. Zero-*g* left a lot of ways to skirt the edges of peripheral vision, but still . . . .

Jay saw her glance around and read her mind. "They're a highly specialized breed of dancers," he said, grinning. "A few of them take class with me. The standard joke is, if you can see one, you don't have to tip him."

Rhea was used to superb service from machines. From human beings it was *much* less common, and a bit unnerving. It made her feel a little like a plantation owner before Civil War One. She reminded herself that these serfs almost certainly made more money than she did—and didn't have to keep thinking up new ideas.

Even Colly, who hated restaurant dining, was impressed. The peanut butter and jelly sandwich she was served (by yet another waiter! They couldn't keep one around just for that; he must be a kind of utility infielder) precisely matched her specifications down to brand and relative proportion of ingredients, and when she challenged the kitchen by impishly requesting an obscure brand of ice cream only sold in Provincetown, they accomodated her without batting an eye.

For all of Rhea's life, "cooking skill" had consisted of selecting the right equipment. It still tended to be the wife who told the equipment to start working, but it had been half a century or more since women's sense of self-worth had depended to any significant degree on the results. Nonetheless, she was mildly irritated to see Rand put away twice as much food as usual.

She managed to find a more acceptable reason to be disgruntled almost at once. A glance around the sumptuous room reminded her of how terrifyingly easy it was to get fat in free-fall. A fat person floating overhead will never again be able to impress you face to face. She had heard that plumpness was fashionable in space—at least among those raised in gravity—but she didn't care if it was.

For his pièce de resistance, Jay let Rand pick up the check . . . making the point that he could now afford to. Colly's eyes grew round at that, and Rand swelled visibly as he thumbprinted the pad.

What can I do? What can I possibly do?

The second press conference was a little more fun than the first, because at least half the time was devoted to asking her to expand on her comments about Rapturism, which by now had acquired an audible capital letter. The fun part was ignoring Martin's frantic attempts to change the subject or put words in her mouth. Book interviews were wonderful training for that sort of thing. And Rand didn't seem to mind sharing the camera—perhaps because this time the implied larger audience were spacers, people he didn't identify with yet. Or perhaps, she had to

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concede, he was just being in love with his wife.

An hour later, on that assumption, she gave him the fuck of his life in the ingeniously designed bedchamber of their lavish new suite, using tricks only possible in free-fall, and drifted (literally) off to sleep curled around his back, furious at him.

The next day she and Colly were peeled away from Rand, and sent on a tour of the hotel with a slender, frail-looking, yet strikingly handsome young Orientator, while the two brothers holed up in Jay's studio to try to salvage what Pribhala had started.

Colly gaped at him when he stated his name. "Duncan *Iowa*?"

Rhea started to chide her, but Duncan only grinned broadly. "My mother was a Frank Herbert fan." Seeing that she didn't get it, he went on, "He wrote a book called *Dune* with a character named Duncan Idaho. So she always wanted a son named Duncan . . . and then she married my dad, Walter Iowa, and just couldn't resist."

Rhea noticed that he did *not* go one step too far, and explain to an eight-year-old Terran that Idaho and Iowa were both the names of states. That was careful diplomacy. He was spaceborn, and would have explained it to another spaceborn, to whom states were distant and remote abstractions. But he could think like an Earthborn, well enough to preserve a child's dignity. She decided she liked him.

So did Colly. "I have the same problem," she said solemnly. "My own parents thought it would be fun to name me after a breed of dog."

Duncan nodded gravely. "That's something to bitch about."

She burst into giggles, and they were friends.

The tour was not the standard first-time first-day grand tour Rhea had taken on her previous trip here. This seemed more like a kind of VIP, behind-the-scenes version. It was still quite impressive, but more intimate, somehow, conveying the added message that only special people got to be impressed in this particular way. "Of course, you'll still be learning things about this place the day before you go back home," Duncan said at one point. "I'm still learning things about it."

"How long have you had this job?" Rhea asked politely.

"I just got it. But I've been coming here since I was a kid."

That long, huh? she thought ironically, but kept the thought to herself.

She swapped bio synopses with Duncan as the tour progressed. He was twenty, bisexual, single, and had a bachelor's degree in molecular electronics from U.H.E.O., which he hoped to parlay into a master's once he had earned the tuition. If only he had been fifteen years older, massed twice as much, had a hairier torso and been muscled more like an Earthborn, she would have considered trying to pair him off with Jay. His parents were both spacers who worked at Skyfac.

Colly's favorite part of the tour was what she instantly dubbed The Blob:

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the Shimizu's famous zero-*g* swimming pool. Located at the very center of the hotel for reasons of orbital stability, it was essentially a large spherical tank, thirty meters across, containing 210,000 liters of crystalline water and happy people.

Of course Colly insisted on going in. You donned breathing and comm gear and four fins, and entered through an airlock. Inside, it was preternaturally beautiful: artistically colored lights were deployed all around and blended to produce shifting effects, and the tank was stocked with multihued fish of tropical breeds—robots, of course, but no less brilliant or beautiful for that. They were absolutely impossible to catch, or even touch: Colly spent a happy time trying. Rhea enjoyed herself almost as much as her daughter. Afterward in the dressing room, Colly announced that air bubbles were prettier in free-fall—and acted more interesting, too.

What Rhea thought was that swimming in P-town was better—whether she did it on the ocean or bay side. But she kept the thought to herself.

When they rejoined Duncan, the first thing Colly said was, "Duncan, how come you don't have muscles, like Daddy?"

"Colly!" Rhea began.

But Duncan cut her off, smiling. "I know that would be a rude question on Terra—but things are different in space. Here it's just a good question."

Colly looked pleased. "So what's the good answer?" she asked.

"Because I don't need 'em. Earthworm muscles—excuse me, Terran muscles—are worse than useless up here. You don't need that much power, and you keep hurting yourself, by pushing off too hard."

"Oh." Colly looked down at her skinned knees, and rubbed a banged elbow thoughtfully. "I knew that: I was just testing you."

"Can I ask you a question now?"

"Sure."

"Back there in the pool—why did you like those angelfish so much?"

"They kept making, like, a flower," she said. "You know, tails together but each head pointing out a different way, like a puffball."

"Don't real angelfish do that on Terra?" he asked.

She stared at him. "How could they? Some of them'd be upside down!"

He blinked, and grinned. "Isn't that funny? I knew real fish can't live in free-fall, because they die without a local vertical to align to; I've read that. But I didn't follow it through and realize they wouldn't ever make puffballs down there."

"That's the difference between book learning and experience," Rhea said, seeing a chance to make this a lesson for Colly. "Duncan was born in space. He knows a lot, but you know things he doesn't."

"And vice versa," he agreed. "That's why I'm here. Over the next couple of days you're both going to get real tired of hearing me repeat certain things. Free-fall safety, vacuum-drill, flare-drill, p-suit maintenance, things like that. And you'll tell me that you know all that stuff, and you'll be right. You know it as book learning. So let me keep bugging you,

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OK? Otherwise you may get in some kind of trouble, from expecting an angelfish to make a puffball."

Colly nodded solemnly. She had been watching the way he handled himself in zero-*g*, and trying to copy his movements, but from then on she would ask his advice, and take it.

"For instance, both of you put in your earphones for a second."

Rhea and Colly both complied.

"I want you to hear a sound without others hearing it. Listen—" He touched a pad at his wrist, and they heard a distinctive warbling shriek. "If you hear that, you have less than twenty minutes to get here to the pool. If you're late, you'll die. It means a bad solar flare is on the way—and this pool is also Shimizu's storm-shelter."

"How long do they last?" Colly asked.

"Anywhere from eighteen hours to three days or so."

"We might have to swim for three *days?*" She didn't seem alarmed. Rhea certainly was.

"Oh, no! They pump the water into holding tanks all around the pool, so it'll do the most good as shielding."

"That thing is huge," Rhea said, "but is it really big enough to accomodate twelve hundred-odd people for up to three days?"

"If they're friendly," he said with a grin. "Don't worry: most flares you're ever liable to see, you can deal with by just getting into the radiation locker in your suite. It takes a Class Three flare to empty the pool, and that hasn't happened in my lifetime. Doesn't mean it couldn't in the next ten minutes—but they've got some real sharp folks modeling the Sun nowadays, plus the Stardancers keep a couple of angels way in past the orbit of Venus all the time, keeping an eye on the old girl. They can send a telepathic warning back to Earth orbit *instantly*, a lot faster than a radio or laser message: when Mama Sol clears her throat, we get a lot better warning than you get of a quake in San Francisco. And in any emergency, trained men in radiation suits will chase down stragglers and sleepers. *But*—and this is what I was talking about before—you can't ever leave safety to machines and other people. Sometimes they goof. If you ever start seeing green pollywogs—little green flashes in your vision—get into that locker, fast. Don't wait for the central computer to tell you to, and don't stop to pee."

After lunch he took them to Wonderland. Both ladies found it delightful. As you approached it, the first thing you noticed was a child-sized white rabbit a little ahead of you, wearing a vest and consulting a pocketwatch. You followed him as he jaunted feet first "down" a long tunnel; onrushing air gave a reasonable illusion of falling in a magical sort of way.

The place into which you emerged lived up to its name.

Colly wanted to stay—forever. After an hour, Rhea was sick of rosy cheer and wanted to go be sullen with her husband. She left Colly with Duncan, agreed to meet them at suppertime, and followed Maxwell Perkins's excellent directions through a maze of unfamiliar corridors to Jay's

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studio. One thing about AIs: they made it hard to be a stranger in a strange land, even if you wanted to be. As long as there was a local database for your AI to invest, wherever you went, you were home.

She paused outside the door, and had Max ask his alter ego—Rand's AI Avatar Salieri—whether she could enter without disturbing her husband: with his assurances she thumbed the door open and jaunted in. The work in progress looked so odd that her eye ignored it, noting only that it seemed to involve some sort of pseudo-underwater visuals and twelve-tone music. She had been married to a shaper too long to expect a rehearsal to look or sound like much.

Rand was drifting a few meters off to her left, upside-down with respect to her local vertical. His body was derelict, relaxed into the classic free-fall crouch, all his attention focused on the dozen writhing dancers who filled the cubic before him. Even upside down she could see that he was scowling so ferociously his forehead looked ribbed. He was making little growling mutters deep in his throat, shaking his head from side to side.

She knew she had never seen him happier.

Damn it.

In that first glimpse of him, utterly intent on his work, she knew deep down, below the conscious level, that she was doomed. She could either live the rest of her life here, or start reliving the glorious single years . . . with an eight-year-old. Her subconscious thought about it, decided her conscious mind did not require this information just now, and tucked it away in the inaccessible node where stories got worked out.

It stayed there for the next month. Every time it tried to get out, she went to work on a story instead. It was a very prolific month. ■

To be continued in the next issue.

He that can take rest is greater than he that can take cities.

Benjamin Franklin

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Robert Zubrin

HOW TO FIND A STARSHIP

Maybe messages aren't what we should be looking for. Think big!

INTRODUCTION

Currently there are many efforts underway worldwide to detect extraterrestrial civilizations by using radio telescopes to listen for communications signals. To date, all such searches have been unsuccessful, and the parameters of the problem, in terms of numbers of stars and frequencies to be examined; the required signal strength, and the ability to distinguish the communication signals of alien life forms from natural phenomena, all suggest that the level of effort of the search may have to be greatly increased before appreciable probabilities of success may be entertained.

In this article I'm going to outline an alternative way to go about trying to detect advanced extraterrestrial civilizations, namely searching for the spectral signature of their interstellar transportation systems. In doing so I'm going to assume technological capabilities on the part of the extraterrestrials considerably beyond those of 20th century humanity. As speculative as such an assumption may seem, I think that it is strongly supported by the fact that our own technological capabilities, as measured by such quantitative measures as scale of construction and power utilization, are currently increasing exponentially on a time scale very much shorter than the life of the Solar System or even the duration of biological species.

The advantage of my approach is that the characteristic power levels associated with interstellar transportation systems are many orders of magnitude greater than those required for communication, and so the signal strength may be much greater. Furthermore, unlike communication which is governed by a fairly arbitrary selection of technology and mutually agreed upon conventions, transportation systems—especially those addressing the daunting challenge of interstellar travel—are governed much more stringently by the laws of physics. No understanding of alien psychology is necessary to detect a starship, and detecting such an object would give us much more valuable

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information than an identifiable but undecodable communication signal.

ASSUMED STARSHIP CHARACTERISTICS

Let's consider four methods of interstellar propulsion, the principles of which are fairly well understood. These are anti-matter rockets, fusion rockets, fission rockets, all of which can be used to either accelerate or decelerate a spacecraft, and magnetic sails, which can be used to decelerate a spacecraft by creating drag against the interstellar medium. We'll also assume that the extraterrestrials have a physiological scale and lifespan which is comparable to that of humans. It may be objected that there is no proof that such assumptions are necessarily true in that we can observe animals on Earth that exhibit significant intelligence that are built on scales one to three orders of magnitude greater or less than humans (squirrel monkeys, sea otters, elephants, dolphins, whales, etc.). In addition certain terrestrial lifeforms have individual lifespans from several hundred (sturgeons) to several thousand (redwood trees) years. Nevertheless, we have one example of a technological civilization of creatures on the human physiological and temporal scale, and while this does not prove that others must be so, it certainly demonstrates that they can be.

The temporal and physical parameters of the extraterrestrials are significant in that they help define the desirable speed and size of what their starships might be. If it is desired that an interstellar journey be completed within the working lifetime of adults who commence it, and if the characteristic distance between stars is about six light-years, then a starship should at least be able to attain a velocity on the order of 10% of the speed of light (0.1 c), which also implies rocket exhaust velocities of the same order. If excessive time is not to be wasted accelerating and decelerating, then it is desirable that the acceleration and deceleration phases each require no more than about 25% of the trip time, which would imply average accelerations on the order of 0.1 m/s^2 (0.01 g). Finally, since technological creatures must also be social creatures, a fair-size crew may be desired for such a long voyage. This is especially true if the voyage is to be one of colonization, which may be the most logical motive for an interstellar trip, as in such a case a large enough group of beings to replicate the civilization's required division of labor at a destination planet must be carried. These considerations, combined with the need for shielding the crew against both cosmic rays and interstellar particles and dust, which will collide with the ship at near-relativistic speeds, imply that the optimum vessel for interstellar travel may be a ship of considerable mass. The maximum size spacecraft that humans can seriously consider assembling on orbit today is one on the order of 1000 tonnes. Such small size is due, however, to current launch vehicle limitations; once in-space manufacturing of components is developed, much larger spacecraft will become practical. A better yard-

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stick for estimating the scale of spacecraft of an advanced spacefaring civilization would be humanity's recent progress in the construction of ships to sail the Earth's oceans. This is illustrated in Table 1.

Admittedly it's a wild guess, but on the basis of the trend illustrated in Table 1, we'll postulate a mass for a "typical" starship on the order of 1,000,000 tonnes. (Large size is also consistent with two of the most probable reasons for interstellar travel: colonization of new stellar systems to spread the domain of one's species; and assault to stop the potential propagation of another.) Taking this assumption together with the exhaust velocity (0.1 c) and acceleration performance (0.01 g) parameters postulated above, the result is that such a starship would require a thrust of 100 MN (22.4 million pounds) and power output of 1500 terawatts (TW).

While the thrust required of this starship is only three times that employed on a Saturn V, the amount of power used is remarkable, equal to 0.9% of the total amount of sunlight falling on the Earth and only 11 orders of magnitude less than the total output of the Sun. For purposes of comparison, humanity today collectively uses about 12 TW, and the most powerful propulsion system ever built, that on the S1 stage of the Saturn V, had a power output of 0.1 TW. On the other hand, humanity's power production is currently growing at a rate of 2.6% per year. If this rate continues, we will produce 1500 TW around the year 2180, and 30,000 TW in 2300. Furthermore, the maximum size of individual power plants has been growing at a rate of two orders of magnitude per century for the past two hundred years. Thus if present trends continue, the apparently astronomical power required of

Table 1. Progress in Nautical Engineering

Ship	*Date*	*Tonnage*
Santa Maria	1492	150 tonnes
San Martin	1588	1100 tonnes
HMS Victory	1803	2200 tonnes
HMS Dreadnought	1900	20,000 tonnes
USS Missouri	1943	65,000 tonnes
USS Enterprise	1965	100,000 tonnes
Current Supertanker	1990	400,000 tonnes

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our standard starship should be commonplace in three or four centuries, a blink of an eye on the cosmic time scale.

FORMS OF STARSHIP RADIATION

Depending upon the type of propulsion system employed, the starship could reveal itself via various forms of radiation.

If anti-matter is employed, then after several intermediate but very short time scale reactions about 40% of the total energy will be released in the form of very hard gamma rays with energies between 130 and 350 million electron volts or MeV (200 MeV would be typical). It would be both difficult and undesirable to block all of these rays from escaping the starship structure, and thus this primitive proton-proton annihilation spectrum could be expected to be radiated to space. To obtain the high specific impulse necessary for interstellar flight, the antimatter would have to be either used to heat a plasma, presumably magnetically confined, or used to heat a radiator to produce thrust in the form of photons. If a plasma confinement system is used, there will be both cyclotron and bremsstrahlung radiation, which will be broadcast to space because there is no need to place a vacuum vessel around a plasma in space.

In order to obtain the maximum specific impulse in an antimatter-fed plasma drive, the plasma will be heated to several MeV (with hydrogen as propellant 20 MeV would produce a theoretical exhaust velocity of about 0.2 c), and will thus produce bremsstrahlung gammas in this energy range. Cyclotron radiation frequency is determined solely by (and is directly proportional to) the strength of the magnetic field employed. If the field strength is 5 tesla, then there will be electron cyclotron radiation at 140 GHz (1.9 mm wavelength) and higher harmonics, along with ion cyclotron radiation at 80 MHz (3.8 m wavelength) and higher harmonics. If photon propulsion is employed, about half of the hard gamma radiation plus all of the rest of the annihilation energy will be thermalized to heat that will be radiated to space by a set of radiators. Because the amount of power that can be radiated goes as the temperature of the radiator to the fourth power, it is highly advantageous to run the radiator as hot as possible. The maximum temperature of the system is governed by the long duration temperature limits of materials, which based upon our current knowledge would be about 2400 K (for tungsten). Radiators operating at this temperature will emit strongly in both the visible and infrared portions of the spectrum. In order to maximize the useful thrust, reflectors will be used to channel the emitted photons into as small a cone angle as possible. A half-angle cone of around 30 degrees might be chosen because cosine losses in thrust due to misaligned photons would be less than 10% while the required size of the reflector would not be excessive. If such a cone angle were used for the reflector, then the apparent strength of the radiation in the direction of the cone

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would be about 15 times the magnitude of the radiation from an omnidirectional source.

If thermonuclear fusion power is employed there will be cyclotron radiation, similar to that produced by the anti-matter ship with a plasma drive described above, and bremsstrahlung, whose frequency will be governed by the plasma temperature spectrum. The optimum fusion reaction for interstellar rocket propulsion may well be D-He3, since nearly all of the energy it releases is in the form of charged particles whose momentum can be converted to thrust. (The need to extract the required He3 from the atmosphere of Jovian planets should not be a serious deterrent to a civilization capable of building the class of starship we are describing.) The products of this reaction, a proton and an alpha particle, are released with energies of 18 and 4.5 MeV respectively, and thus some gamma rays may be expected with energies in this range. However the optimum power/mass ratio fusion reactor will be realized if the plasma temperature is kept such that the ratio of the reaction rate parameter divided by the square of the temperature, $<\sigma v>/T^2$, is maximized. For the D-He3 reaction this will occur at an average plasma temperature of about 60 kilovolts or keV. The bremsstrahlung emittance from such a reactor will thus be dominated by x-rays in this frequency range.

Fission could be employed either as an electric propulsion system or as a sort of plasma drive using a variety of techniques. Whatever the conversion system, the unique signature of a fission drive would be the well-known spectrum of prompt and delayed fission gamma rays, in the 0.5 to 5 MeV range, collectively accounting for about 14% of the total output produced by the reactor. If fission is used in a plasma drive it could also be easily distinguished from either a fusion or an antimatter system by its ion cyclotron radiation, about two orders of magnitude lower in frequency than that of the alternatives due to the high atomic mass of the magnetically directed fission products. If the fission source is used for electric propulsion, then its radiators will operate at a lower temperature compared to those possible in a photon rocket, because the efficiency of the electric propulsion conversion system will go to zero as the radiator temperature approaches the temperature of the hot side of the energy conversion cycle. It can be shown analytically that the optimum ratio of the maximum temperature (absolute) to the radiator temperature in a space electric conversion system is 4:3. Thus an advanced electric propulsion system would operate with a radiator temperature at around 1800 K, emitting in the visible and IR.

A magnetic sail (or "magsail") would be of unique value to an interstellar spacecraft because of its ability to decelerate a ship without the use of propellant. The magnetosphere of the magsail will create a standoff collisionless bowshock, which will heat the interstellar medium it encounters to hundreds of keV to a few MeV, depending upon the ship velocity. The

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plasma so created will then encounter the magnetic field of the magsail, where it will emit cyclotron radiation.

The rate of deceleration of a magsail spacecraft[1] in an interstellar medium is given by:

$$dV/dt = -0.6(\mu\rho^2V^4R_m/I)^{1/4}(J/\rho_m)/W \quad (1)$$

where V is the ship's velocity, ρ is the ion density of the interstellar medium, μ is the magnetic permeability of free space $= 4\pi \times 10^{-7}$, R_m is the radius of the magsail loop in meters, I is the current in the loop in amps, J/ρ_m is the wire current to mass density ratio (Amp-m/kg), and W is the ratio of the mass of the total spacecraft to the magsail loop alone. If we assume $J/\rho_m = 2$ MA-m/kg (NbTi), R = 1000 km, I = 159 MA, W = 2 (a 500,000 tonne magsail with a 500,000 tonne payload), $\rho = 1.67 \times 10^{-22}$ kg/m^3, this becomes:

$$dV/dt = -2.8 \times 10^{-12}V^{4/3} \quad (2)$$

The solution to this equation is:

$$V = V_0/(1 + 7.9 \times 10^{-13}V_0^{1/3}t)^3 \quad (3)$$

By giving the deceleration, equation (2) gives the magnitude of the power of the magsail, while equation (3) gives the time profile of the change in frequency of emitted magsail radiations. This is because as the velocity of the ship decreases, its Mach number decreases and so the temperatures resulting from shock heating will fall as the square of the velocity. Also since the boundary of the magnetic field of the magsail will be determined by the location where:

$$B^2/2\mu = (\rho V^2/2)\cos\theta \quad (4)$$

where θ is the angle between the free stream and a line perpendicular to the surface of the magnetosphere, the magnetic field at the boundary will decrease in direct proportion to the velocity. Since the frequency of the cyclotron radiation is given by:

$$\omega = qB/m \text{ (radians/sec)} \quad (5)$$

it will also fall according to the exact same time profile. The decline in bremsstrahlung energies and cyclotron frequencies in time in accord with the form of equation (3) would be a dead giveaway that the emitting object was a decelerating magsail.

The cyclotron frequency emitted by a magsail is not a function of spacecraft design, but only of the ship's velocity and the density of ions in the interstellar medium. At a density of 1 ion/cc, a ship traveling at 0.1 c would produce electron cyclotron radiation at a frequency of about 12 kHz.

MAGNITUDE OF STARSHIP RADIATION

The magnitude of the radiation that a starship will emit is a function of the magnitude of the power of its rocket engine, as well as of the engine design. For some types of engines, the fraction of jet power emitted as certain types of radiation can be calculated accurately. Where such information is lacking, I have generally assumed that the magnitude of a major type of radiation generic to an engine is about 10% of the jet power.

The jet power is calculated as follows: If we assume a characteristic distance of six light-years for an inter-

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stellar voyage, and let the acceleration time equal ¼ the trip time, then since 1 g is also an acceleration of the speed of light in a year, we have:

$$S = 6 \text{ ly} = Vt/2 + (t/2)(V/2) = 3/4Vt \text{ or } t = 8/V \quad (6)$$

$$A = 4V/t = V^2/2 \quad (7)$$

where V is the maximum cruise velocity, t is the trip time, S is the trip distance, and A is the time-averaged acceleration.

I think it is logical to also assume that a more advanced starship technology would only be employed to achieve performances substantially beyond what a more primitive technology might do. Thus since fusion can achieve a velocity of 0.1 c, we should place a demand on an antimatter plasma rocket that it be used to achieve 0.2 c. If we use these equations together with:

$$P_{jet} = FU/2 = MAU/2 \quad (8)$$

where F is the engine thrust and U is the exhaust velocity, and assume a time-averaged mass during the burn, M, of 10^9 kg, we can find the characteristic power level required of each of the technologies discussed. The results are shown in Table 2.

DETECTION OF STARSHIP RADIATION

Gamma Rays

Looking at Table 2 you can see that certain potential starship propulsion systems, notably the very high power antimatter drives, emit vast quantities of energy in the form of gamma rays. The problem with detecting such radiation however, is that since each gamma ray carries a large amount of energy, the number of photons emit-

Table 2. Characteristic Power Levels of Interstellar Propulsion Systems

Technology	*U/c*	*V/c*	*A(g's)*	P_{jet}*(TW)*	P_{rad}*(TW)*
Fission Electric	0.02	0.02	0.0002	6	1@1-5 MeV, 18 @visible/IR
Fusion Plasma	0.08	0.1	0.0002	6	1@1-100 keV, 60 cyclotron
Anti-Matter Plasma	0.2	0.2	0.02	6000	4000@2000 MeV, 600@20 MeV 600cyclotron
Anti-Matter Photon	1.0	0.4	0.08	120000	40000@200MeV 120000 visible/IR
Magsail fission	-----	0.02	0.0003	18	2@80 KeV, 2@2.4 kHz
Magsail-fusion	-----	0.1	0.026	780	80@2MeV, 80@12 kHz
Magsail-AM Plasma	------	0.2	0.0065	4000	400@8MeV, 400 @ 24 kHZ
Magsail-AM Proton	-------	0.4	0.0166	20000	2000@32 MeV, 2000@48 kHz

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ted by even a very high powered starship at a characteristic interstellar distance impacting per square meter of collection area is quite small, and thus extremely difficult to distinguish from instrument noise and background radiation. For example, a starship emitting 10,000 TW of 200 MeV gamma radiation at a distance of 1 light-year from Earth will cause 7.5 photons *per year* to impact on a 1 square meter collection device. This would obviously be undetectable.

X-Rays

Because their characteristic energies are about 4 orders of magnitude less than gamma rays, starship X-ray emissions offer some promise of increasing the photon count to detectable levels. On the other hand, the magnitude of the power source on those types of propulsion systems that emit x-rays appears to be about 2 orders of magnitude less than those characteristic of anti-matter drives. A starship at 1 light-year emitting x-rays at a rate of 1 TW/keV (i.e. 50 TW at 50 keV, etc.) would impact a collection device in Earth orbit at a rate of about 0.02 photons per hour, which would still be statistically undetectable. However a portion of the X-ray emissions would be less than 2 keV, and such radiation could be concentrated by an X-ray grazing incidence telescope. If such a telescope could be constructed that would focus a 1 m diameter aperture down to a 1 cm diameter collection area, then a 1 TW/keV (2 TW at 2 keV) source at 1 light-year would cause 160 impacts per hour on the collection plate, which would be statistically detectable. One light-year is not a very great detection distance capability, however. At 10 light-years, a neighborhood within which there are less than a dozen target stars, the impact rate would be about 2 per hour and the signal would fade into the noise background.

Visible Light

While the gamma ray emissions from the engine of an antimatter photon rocket would be undetectable, the visible radiation composing its exhaust is another story. If we consider the sample photon rocket in Table 2, with a jet power of 120,000 TW, and assume that it uses a reflective nozzle to focus the emitted light to a half angle of 30 degrees, then it will shine in the direction of its exhaust with an effective irradiated power of 1,800,000 TW. Such an object at a distance of 1 light-year would be seen from Earth as a 17th magnitude light source and could be detected on film by a first class (12 inch diameter or better) amateur telescope. The 200-inch telescope on Mount Palomar could image it at 20 light-years, and it could be detected by the Hubble Space Telescope at a distance of about 300 light-years. Curves of apparent magnitude versus distance are shown in Fig. 1, as are the number of stellar systems ($N = R^3/80$) within range. Since at least for the upper-end telescopes considered, the number of stellar systems within range is significant (100,000 stars are within 200 light-years of Earth) this approach offers some hope for a suc-

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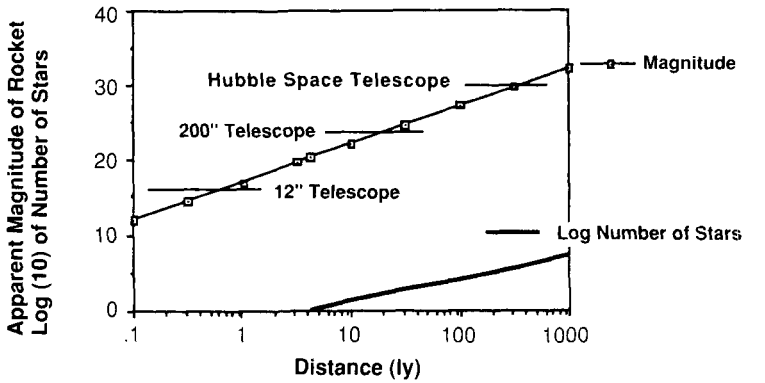

Figure 1: The visible emissions from an anti-matter photon rocket could be detected over interstellar distances by existing telescopes.

cessful search. The light from the photon rocket could be distinguished from that of a dim star by the lack of hydrogen lines in the rocket's emissions.

Radio

Radio waves may be emitted from a starship as a result of plasma interaction with either the magnetic confinement field of a plasma drive engine or the deceleration field of a magnetic sail. Plasma drive engines produce electron and ion cyclotron radiation with frequencies on the order of a hundred GHz and MHz, respectively. Magsails produce electron cyclotron radiation with frequencies of tens of kHz and ion cyclotron radiation with frequencies of tens of Hz. The frequency of plasma drive engines is thus high enough to penetrate the Earth's ionosphere and be detected on the ground by radio telescopes, while magsail radiation is below the ionosphere's cutoff frequency and can only be detected by antennas positioned in space.

The signal to noise ration (SNR) of a radio receiver is given by:

$$SNR = P(A_r)/4\pi R^2 BkT \qquad (9)$$

where A_r is the area of the receiver antenna, R is the distance from the source, P is the radiated power of the source, B is the bandwidth, k is the Boltzman constant, and T is the absolute temperature of the receiver. Since plasma confinement fields and magsail fields both vary by factors greater than two over the region of plasma contact, the bandwidth required to capture a large percentage of the signal must be a sizable fraction of the signal's peak frequency. Thus (because of its lower frequency) with the same size antenna and power source, magsail radiation can pro-

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duce a SNR six orders of magnitude greater than that possible from a plasma drive. Furthermore, since the low frequency magsail radiation has very long wavelengths (12 kHz = 25 km wavelength), huge collection areas can be created with very little mass by orbiting dishes or antennas made of sparsely placed wires or crossed tethers. For these reasons, magsail cyclotron radiation will be much easier to detect than that from plasma engines.

If we assume a SNR of 2 and a bandwidth of 1 kHz, sufficient to capture a significant fraction of electron cyclotron radiation emitted by a magsail (we assume 10% of the emitted electron cyclotron radiation within this bandwidth), and orbiting antennas with effective equivalent radii of 6 km and 30 km respectively, then the power that needs to be emitted by a magsail for it to be detectable on Earth is shown in Fig. 2.

It can be seen that the magsail radiation of a characteristic fusion starship being decelerated from a cruise velocity of 0.1c could be detected by a 6 km orbiting antenna from a distance of 400 light-years, while that emitted by a characteristic anti-matter photon rocket in its deceleration phase could be seen as far away as 2,000 light-years. There are about 100,000,000 stellar systems to be found within the latter distance. This extended range detection capability combined with magsail radiation's unique time-dependent frequency spectrum appears to make a search for magsail radiation the most promising option for extraterrestrial starship detection.

As I said before, our estimate of starship mass is a speculative guess.

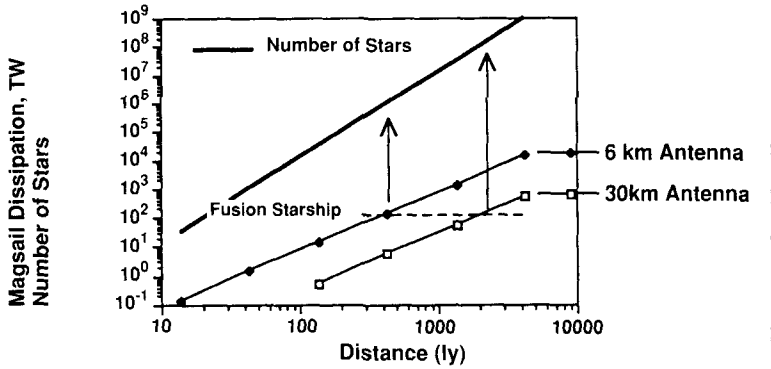

Figure 2: Detectability of magsails over interstellar distances. If a 6 km orbital tether is employed as an antenna, then a typical starship could be detectable at distances on the order of 400 light-years. There are about a million stellar systems available for examination within this distance.

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However since the signal detectability is proportional to the mass of the ship (magnitude of emitted radiation) divided by the distance squared, a decrease of ship mass by two orders of magnitude only results in a drop in detectability distance by one order of magnitude. Thus even if the true characteristic mass of starships is 10,000 tonnes, and not the 1,000,000 tonnes baseline, magsail radiation would still be detectable by the 6 km antenna at 40 light-years, and by the 30 km antenna at 200 light-years.

CONCLUSION

In this article we've taken a quick look at a few of the interstellar propulsion technologies that may be in current use by many of the advanced extraterrestrial civilizations that almost certainly populate our Galaxy. Of those considered, the ones most likely to be detectable are photon rockets and magnetic sails. Photon rockets could be detected by currently existing orbital equipment at distances of several hundred light-years, while magsails could be detected by near-term deployable orbital equipment at distances of several thousand light-years. Both systems would emit signals that could easily be distinguished from natural sources.

It might be said that it is the height of arrogance to assume that civilizations far more advanced technologically than we would use such primitive propulsion systems. I do not believe that such an objection is valid. According to our understanding of the laws of the Universe, there can be no more effective means of accelerating a starship than an anti-matter photon drive, and no more effective means of deceleration than a magnetic sail. While communication technologies are a matter of convention, propulsion is constrained by physics. Unless we are just plain wrong about physical law, an anti-matter photon drive must be the ultimate rocket because $E = mc^2$ says that anti-matter is the densest form of energy storage possible and special relativity says that light speed is the fastest exhaust velocity you can get. Similarly the magsail must be the best decelerator because it requires no internal or external power source and no on-board reaction mass. Magsails will still be used by super-advanced cultures for the same reason that, despite enormous advances in aviation since their invention in 1783, parachutes are still used today; pick your century, the easiest way to slow an object moving through a fluid is to create drag.

But what if, one asks, our understanding of physical law is just plain wrong? My answer is that we cannot proceed on the basis of such an assumption. The basis of all science is the conceit that human reason can comprehend the Universe; the basis of all engineering is the conceit that the scientific laws so derived are true and represent valid relations governing what is and what is not possible in the way of manipulating matter and energy in our Universe.

Don't mistake my meaning—I really don't have a closed mind. I do not

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doubt for a minute that humanity's current knowledge of the laws of physics is incomplete, incorrect, and at least partially absurd (if you don't believe that, try reconciling the law of conservation of matter/energy with the origin of the Universe.) What I am saying is that if we have even a fair handle on physical truth, then extraterrestrials, however advanced they may be, will be moving about by means we can predict and we should be able to see them. If we can't see them, it means that we've missed something really big.

That's why we'd better get serious about looking.

REFERENCE

1. R. Zubrin, "The Magnetic Sail," *Analog,* May 1992.

Man is not logical and his intellectual history is a record of mental reserves and compromises. He hangs on to what he can in his old beliefs even when he is compelled to surrender their logical basis.

John Dewey

Men are apt to mistake the strength of their feeling for the strength of their argument. The heated mind resents the chill touch and relentless scrutiny of logic.

William E. Gladstone

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Hayford Peirce

SIX MILLION SOLID GOLD BELTER BUCKLES

One thing economists and SF writers can agree on is that predicting futures is risky business!

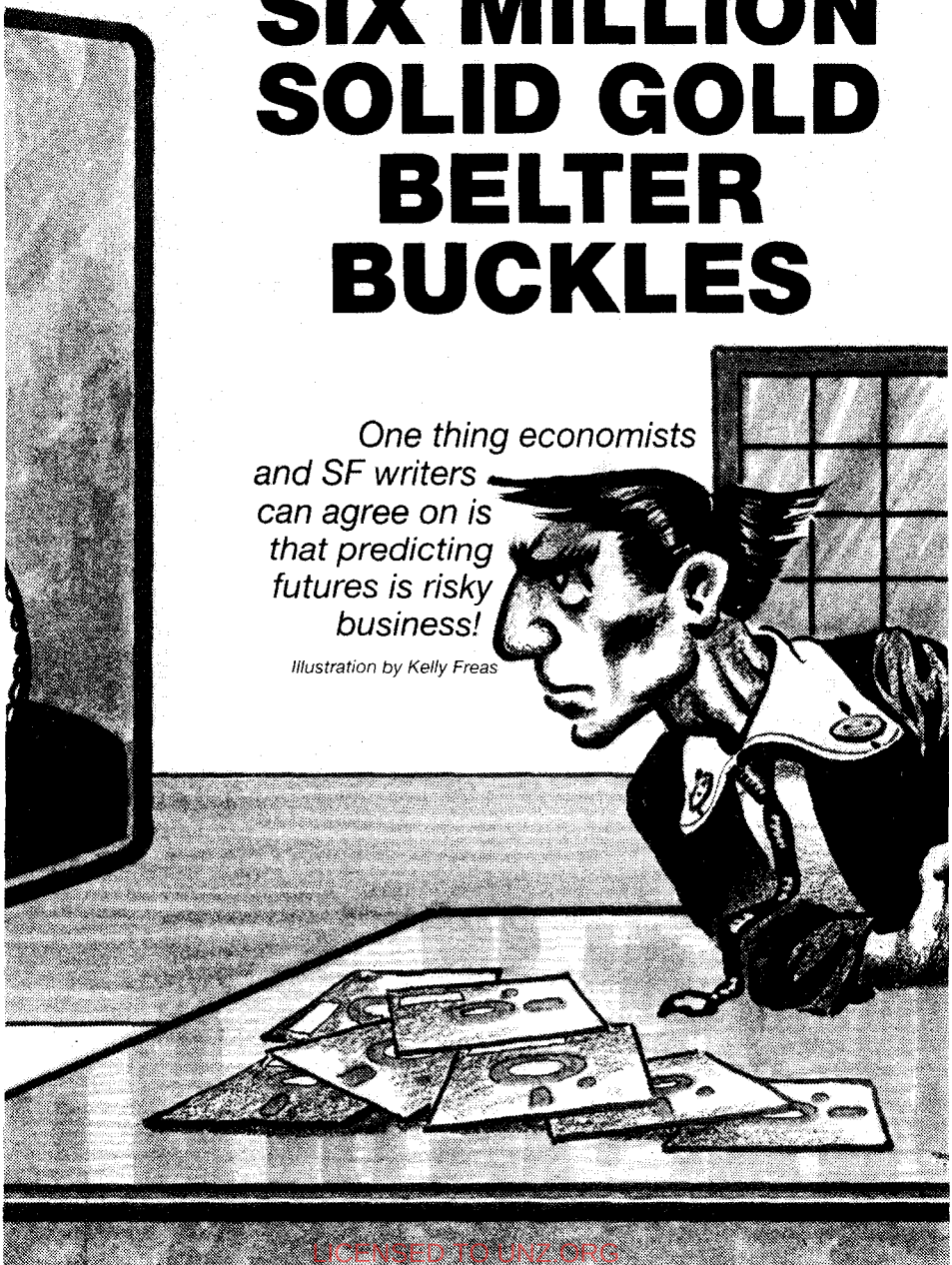

Illustration by Kelly Freas

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"You've lost all my money!"

I seriously doubted that—Jessica Maynerd was almost certainly the wealthiest woman in Clarkeville, the eighth largest city in the Asteroid Belt—but it still wasn't the kind of accusation that a highly ethical stockbroker like myself likes to hear from a client first thing in the morning. My instinctive reaction was to grind my teeth and utter a sharp little scream. Instead, I pushed my features into a portrait of puzzled concern and leaned closer to the eighty-seven-year-old face that glared so malignantly from my deskphone. "I don't understand, Granddame Maynerd," I murmured, using the flowery Cerean honorific for ladies of a certain age and status that rhymes with *random*. "All your stocks are doing very—"

"It isn't my stocks I'm concerned about, Jonathan White! It's the six million buckles I've lost on those titanium futures you talked me into buying, you and that shifty-eyed boss of yours!"

I fell back in my chair, aghast at so monstrous a lie on the lips of one so old and venerable. *She* was the one who had insisted on throwing a million buckles into the bottomless black hole that was the commodities market! *I*—Jonathan Welbrook White, Ethical Broker & Bourseman—had done everything short of falling to my knees in trying to dissuade her from such criminal folly!

I stared open-mouthed at the daughter of the founder of Clarkeville—while a glistening tear actually rolled down from her gimlet eye and across a wrinkled cheek. "Have you seen the price of titanium futures today?" she whimpered in a piteous voice. "And now I'll have to sell all my other stocks just in order to—"

"Just a moment," I interrupted, rapidly punching keys on my console. As usual when I was upset, I punched a little too vigorously and bounced a good half meter out of my seat before I caught myself. Cerean gravity is only .04 Standard, I reminded myself, but Newton's law of action and reaction is universal.

I grimaced apologetically and told my fingers to relax. A few seconds later the figures on the brightly colored screen flickered, churned sickeningly, and went dark—along with all the lights in the office. I muttered a silent curse: the Clarkeville Department of Citizens Service had been promising to bring our new power station on line for two years now, and we were *still* having constant power failures, particularly after the further disruptions caused by last March's ceresquake at Harvey's Hollow. Worse, our own emergency standby power hadn't been working the way it was supposed to. This morning, however, power returned within a few seconds and I turned back to the data on the screen. I studied it with a cold, clammy feeling of acute dismay.

At least a part of what Granddame Maynerd had said was absolutely true: the price of titanium, and particularly that of its futures, had fallen out of bed with a thud that ought to have been audible across the Solar System. Had, in fact, been doing so for the past six weeks while I had been busy trading mundane stocks and bonds

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for those of my clients who were too sensible to cast away their patrimonies in the mindless speculation of commodities trading.

So what could I, an ethical stockbroker, now reasonably do?

I spread my hands in a gesture of baffled sympathy. "As you say, Granddame Maynerd, titanium doesn't look so good right now. But you remember that I *did* warn you about the risk involved—"

"Nonsense! You said nothing of the sort! All I remember is you and that bullying manager of yours browbeating me into—"

"But . . . but—"

"—Into putting all my money in titanium futures! Not only that, I distinctly told you to go short, and here you are deliberately going *long!* If you'd gone short like I told you, I've have made millions of buckles. Instead, I've *lost* six million! Six million solid gold Belter buckles, Jonathan White, the only stable currency in the whole Solar System! If your company doesn't refund all my money—with interest!—and rescind the whole transaction, I'm going to sue you personally, Jonathan White, and I'm going to sue that troglodyte manager of yours, J. Davis Alexander, and I'm going to sue that fly-by-night firm of yours, Hartman, Bemis & Choupette, whoever *they* may be! Goodbye, young man. The next communication you have from me will be from my lawyers! And from the Procurator General!"

The deskphone went blank. I stared at it equally blankly for what seemed like a long while. Finally I told my secretary to handle all business for the indefinite future, checked to make sure that it was actually powered up, rose to my feet, squared my shoulders, and marched off to see my troglodytic boss, the aptly described J. Davis Alexander.

My natal world of Ceres has a surface area of 3,302,461 square kilometers, just about the size of the Terran political unit called the Indian Union. Its population of 9,736,486 men, women, and others as of 9:35 A.M. July 16, 2278, wasn't much for an entire world. On the other hand it's not bad for a hunk of carbonaceous chondrite rock with no atmosphere and no oceans whose first permanent settlement was established not quite a hundred years ago.

Even Clarkeville, only the fourth largest city on the asteroid, has a population of almost 300,000 people. But what's aggravating about it is that out of all these millions and millions of people on Ceres *one* of them has to be J. Davis Alexander. Even more aggravating is that of all the possible occupations said J. Davis Alexander could have chosen to match his talents and personality—I have in mind zoo attendant or sinkhole inspector—he chose instead to work his way up to the top of the local stockbroking branch of Hartman, Bemis & Choupette.

Now his baleful eye fixed me from across the broad expanse of his green malachite desk while he cracked the hairy knuckles of one hairy hand after the other. Except for the surface of those baleful eyes, J. Davis Alexander

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was hairy all over, in addition to which he was without doubt the shortest, stoutest human being in the entire Asteroid Belt. His parents, I believe, had, for religious reasons, systematically refused to take their gravity pills. Or maybe it was J. Davis Alexander himself who refused to take them.

Whatever the cause of his strange shape, if Clarkeville had actually *had* a zoo, instead of a single duck pond, its board of directors would have been hard put to decide whether my boss should be employed as an attendant or as an exhibit; most probably with the wolverines, that being the beast that most closely matched his winning personality.

Instead, contrary to the simplest notions of elementary justice, J. Davis Alexander had a fine corner office with a view of the duck pond in Westlake Park, a six-figure annual income, and an adoring wife at least half a meter his superior in height.

J. Davis Alexander popped a final knuckle, pursed his fleshy lips, and tugged at one end of his handlebar moustache. I knew from long experience what he was going to say, to wit: "White, you're fired."

To my astonishment, however, he merely said, in that voice that sounds like gravel rattling around inside a maladjusted concrete mixer, "What's all this nonsense from this Maynerd woman, White? I've just had one of her lawyers trying to get through to me. I've put him off till I talked to you."

"There's not much to say," I shrugged. "As you know, she's one of our biggest clients in terms of net value. Very rich, very conservative. She's been with us for at least forty years. I inherited her account when old Wigglesworth retired. Everything in her portfolio's in blue chips and triple-A bonds, nothing she could ever conceivably lose a nickel on. No one here's making a centavo on her: she hardly buys or sells anything from one decade to the next."

"So what's with the titanium futures?"

The glare I directed at J. Davis Alexander was in the same league as his own for high-intensity balefulness: he knew perfectly well what was with Granddame Maynerd and the titanium futures. Nevertheless, just for the record, I explained. "A year or so ago she started getting cold calls on her vu-mail from a broker named Wivvel at the Three Blind Mice over on Pallas, about how much money he could make for her in futures trading."

J. Davis Alexander rolled his eyes in indignation and righteous disgust: the Three Blind Mice—actual name Bleine, Blinder & Miesen—are our principal rivals throughout the Belt in the field of ethical stockbroking. Incorporated on Pallas, a Libertarian's paradise where regulation of the securities markets is close to nonexistent, the Three Blind Mice frequently give new and inventive dimensions to the word *ethical*. "Bohuslav Wivvel?" muttered J. Davis Alexander incredulously. "Bo *Wivvel*? I thought he'd been enjoined for life from ever working in the securities field again after that Ganymede

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Bubble fraud."

"Only on Ceres and Vesta; on Pallas he was snapped up as soon as he got out of Confinement Rock. Old lady Maynerd never actually *talked* to him, of course, but she did listen to all of his vu-mail. And after a while she started calling me to ask about titanium futures, that being what this Wivvel creature was trying to get her to put her money into. Naturally I told her in a polite way that she was absolutely crazy. Finally, last March 26th, she *ordered* me to go long on ten million buckles worth of futures for delivery next December. That was when I said we had to see *you* in order to open a commodities account."

"See *me?*" J. Davis Alexander's habitual scowl deepened and he tugged fretfully at the unruly beard that spilled across his rotund breast. "I certainly don't recall—"

"As bureau manager you don't recall that anyone wanting to open a commodities account for even a hundred buckles has to sign a 9,000-word waiver, disclaimer, and general quitclaim in the actual physical presence of the bureau manager?" I snarled. "Stating that she recognizes the inherent risks of speculating in commodities and that she specifically holds Hartman, Bemis & Choupette free of—"

"Yes, yes, perhaps I do," muttered J. Davis Alexander sulkily. "Tiresome old bat, as I recall. I distinctly recall trying to talk her out of getting involved in such risky investments at her age."

Tactfully, I said nothing. J. Davis Alexander had been as eager as the unspeakable Bo Wivvel and the Three Blind Mice to see how much money our agency could siphon off from the Clarke-Maynerd fortune by judicious churning of the futures market. Ashamed to meet my eye, he swiveled around in his overstuffed chair to contemplate his million-buckle view of Westlake Park.

This morning it was far from inspiring: the city's waste management engineers had been on strike for three weeks and for lack of any better place the local citizenry had been dumping their rotting garbage bags in the park. Towering mounds of lumpy brown bags now obscured the edges of the duck pond and threatened the carousel. A family of baby ducks was learning to fly in our barely noticeable gravity by jumping off the mounds, flailing desperately through the air, and finally falling with enormous splashes into the barely cohesive water. Bright shards of water pinwheeled slowly through the air.

The chair swiveled around again: J. Davis Alexander's face had cleared. He had just remembered that the waiver signed by Granddame Maynerd was an absolute safeguard against the firm's assuming any liability in the case of investment losses. "Ha!" he grunted triumphantly, stabbing a pudgy finger at the controls of his concealed console. "White, why do you persist in wasting my time like this? Just let me pull up a copy of that waiver so that we can wave it at—" He broke off to glare at his screen. "That's funny, I can't *find* it. I *know* she signed it, right on that deskpad that's right there in front of you. . . ."

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I glanced down at the glowing white surface of the built-in deskpad in the otherwise shiny green top of his malachite desk. Yes, that was where I had watched Jessica Maynerd sign her name to the ironclad waiver that stood between us and a trillion-buckle lawsuit.

Only . . . only our accounts department now seemed to have no record at all of the waiver.

Nor did Granddame Maynerd's personal file.

Nor did Central Registry at City Hall.

J. Davis Alexander removed his stubby fingers from the interface and began to shout instructions at the computer.

Then orders.

Finally threats.

Twenty minutes later he looked at me with eyes that were more haunted than baleful. "I . . . I remember now," he croaked in a hoarse whisper. "That was the day the city power went off all afternoon because of that damned ceresquake over at Harvey's Hollow, the same day we were installing the new information backup system and overhauling the standby power system. It must . . . it must—" he stared helplessly at his immaculate paperless desk as if now, a full half-century after a piece of paper had last crossed a desk at Hartman, Bemis & Choupette, he might find it miraculously covered with sheaf upon sheaf of thick paper contracts and trade confirmations. "It must have somehow messed up the information system so that the waiver wasn't recorded."

Now J. Davis Alexander finally spoke the familiar words I had been waiting for: "White, you're fired!"

The next day I went to work as usual. Just because it looked as if sometime in the near future I might be excavating nickel-iron ore from Confinement Rock the old-fashioned way, with a sledgehammer and shovel, there was nothing to be unduly gloomy about: at least I'd have the distinct pleasure of watching J. Davis Alexander wielding his own hammer next to mine.

No sooner had I conjured up this pleasing image than his infinitely less pleasing head of all too solid flesh and bone popped around the corner of my cubicle. "White! What on Ceres are you doing here? You were fired, remember? Now—"

"I'm playing around with the computer," I said shortly. "I *know* she signed it while the power was on. *Somewhere* in here there has to be a record of—"

"Ha! I *told* you after that power failure to make sure all the records had been restored!" J. Davis Alexander's nostrils distended. "White, you're fired!"

I nodded wearily. "I know. But the law says that you have to give me thirty days' notice, with full payment."

"I do? The law says *that?*"

"Yes."

"Oh. Well, in that case, you can spend your time turning your accounts over to my nephew, Horton—he'll be joining the firm to take over your job."

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I managed a hollow chuckle. "Firm? What firm? When the court hears in tearful detail how we browbeat the eighty-seven-year-old daughter of the founder of Clarkeville into losing six million buckles in titanium futures, and then awards her a billion buckles in punitive damages, there won't *be* a firm!"

"Ah. I hadn't thought of that." J. Davis Alexander's hairy head vanished with the same abruptness with which it had appeared.

Twenty minutes later my secretary beeped to tell me it had just received a vu-mail. "Who is it?" I muttered without looking up from my fruitless wanderings through the dark soul of the world's information system.

"A Mr. Bohuslav Wivvel, calling from Pallas."

My eyebrows shot up. "Real time?"

"No, Mr. White. Pallas is currently 1.27 AU's ahead of Cerean orbit. The real-time differential is ten minutes and thirty-six seconds."

"Of course. Very well, put him on."

The upper half of the infamous Bo Wivvel appeared on my deskphone. He seemed prosaic enough for a bucket-shop swindler who had recently spent three years shoveling ore on Confinement Rock. He was as long and lean as most Belters, had an elaborate tattoo on his right cheek, apparently of a hummingbird sniffing at a flower, a long gold earring dangling from his left ear, and a muted checkerboard pattern on his eyelids. All in all, a typical enough example of a conservative young stockbroker on the way up. His recorded image smiled at me warmly from 190 million kilometers away.

"*Good* morning, dear colleague," he chirped. "Bohuslav Wivvel here. I just thought I'd give you a call to thank you for everything you've done in helping Granddame Maynerd decide to move her main account over to my office. Without your fine work on her titanium futures I'm sure she would never have considered such a move." His smile broadened. "Ah, that *reminds* me. I convinced her that she could safely leave her present little commodities account in your own capable hands: after all, the courts *will* want it as evidence." He swooped his head in an elaborate, mocking bow. "*So* nice talking to you, dear colleague."

I cut the deskphone in the middle of his gale of cackling laughter. Then I sat staring at the screen, wondering how many additional years it would cost me on Confinement Rock if I jettisoned Bohuslav Wivvel through the main Pallas airlock.

I was interrupted in my reverie by a squishing sensation around my toes. I looked down to see that my sandaled feet had vanished beneath the murky water swirling across my cubicle floor. I leapt to my feet with a cry of rage—and, of course, bumped my head painfully against the ceiling. I cursed and waited while I drifted slowly back into the churning maelstrom.

Something had obviously gone wrong with the Clarkeville sewage and recycling system: it seemed to have mistaken the offices of Hartman, Bemis & Choupette for the Pleasanton bean fields twenty kilometers

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away and was now pumping its daily irrigation quota into the cubicles of inoffensive third-story stockbrokers.

Enough was enough.

I decided to go for a drink.

"What I don't understand," said Isabel above the usual din of the Café des Mondes, "is all this stuff about futures, and going long and going short and making a fortune or losing a fortune in the time it takes to turn around and why it's too dangerous for mere mortals like me to play around with."

"It's easy to understand," I said. "Look, you know how you can sell a stock short in a regular stock account—"

"No, I've never understood that either." Isabel held up a hand. "And please don't tell me. All I want to know about is this futures business that's got you so upset."

I looked at her with pursed lips for a moment, then raised my tall beaded glass of nicely chilled Pernod to said lips. Isabel was infinitely pleasanter to look at than the piled-up bags of smelly garbage that now blocked our view of the café's normally agreeable perspective of Westlake Park. She's about my age, twenty-eight or twenty-nine if it matters, nearly as tall as I am, but far rounder and smoother in places of interest to practicing heterosexuals like myself.

Three or four years ago Isabel and I had planned to get married and have a couple of children, but Psych Service had turned us down. Isabel's latent attraction to other women, they said, made the chances of the two of us having a successful twenty-three year marriage something less than 25 percent. That assessment had come as a vast surprise to Isabel, who had always considered herself as straight as a mathematician's line, but who could argue with Psych Service? And if you want to have children on Ceres you have to guarantee that there'll be a stable family environment until the child reaches his or her twenty-second birthday.

So no wedding bells for Jonathan and Isabel. Instead she married a lovely girl named Jin Tshei and they lived more or less happily ever after. A little while after the marriage I was invited to contribute the necessary genetic material for the creation of an adorable little girl. Now I dropped by for pleasant weekends with Isabel and Jin Tshei and three-year-old Valérie-France two or three times a month.

And the two of us still had occasional drinks together at an outside table at the Café des Mondes while empty saucers piled up before us and schmaltzy accordion music played softly in the background. She has a high-powered job in the assessor's office of City Hall and normally never wants to talk about the mundane ins and outs of the brokerage business. Now, however, she did.

I gestured at the lifelike waiter in the old-fashioned black suit and white apron for another round. "If you want to understand how an old lady moneybags can lose six million buckles in futures you have to understand two things. The first is margin."

"Margin?"

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"Margin. When a solid financial citizen like yourself buys 100 shares of Magnus Mining at 75 buckles a share, you debit your account for 7,500 buckles and pay it over to whoever's selling you the shares, along with an itty-bitty commission for your friendly stockbroker. You in turn receive a certificate proving you own the stock."

"All right," said Isabel tartly. "Even though my two degrees happen to be in resources allocation management and not financial flimflammery, I think I can grasp that subtle concept."

I actually managed a faint grin. The Pernod was definitely making the world seem a little brighter. "Now it gets a trifle harder. If you wanted to, you could have opened a *margin* account. That would have let you buy *200* shares of Magnus Mining for the same 7,500 buckles. You would have put up your own 7,500, and the brokerage firm would have lent you the other 7,500. But instead of delivering the 200 shares to you, the brokerage house would have kept them as security against its loan of 7,500 buckles. And every month you would have to pay interest on the loan. Clear?"

Isabel frowned. "I think so. I'd buy shares on margin because I'd hope the price per share would go up enough so that when I sold them I've made enough profit to pay off the additional interest I had to pay."

"Right. And because you owned 200 shares instead of 100 you'd have had twice the profit for essentially the same amount of investment. That's why people like to play around with margin accounts. But with stocks, which are pretty closely regulated, at least here on Ceres, you can only buy stocks on 50 percent margin. In other words, for every buckle you borrow from the brokerage house, you have to put up one of your own."

"All right, that seems clear enough. But what has margin got to do with futures and why the Procurator General will try to stick you in Confinement Rock?"

I snorted angrily. "Because with commodity futures you don't have to put up 50 percent margin, you only have to put up *10* percent! That means you can buy a million buckles worth of pork belly futures by only putting down a hundred thousand buckles of your own. So if the price of pork bellies goes up, you can make *ten* times as much money as if you hadn't bought on margin. Which means that everyone who wants to make a quick buckle is playing around with commodities."

Isabel looked at me plaintively. "But you *still* haven't told me what a future is."

I looked up at the green and white stripes of the café's picturesque but completely unnecessary awning —after all, we were sitting at least sixty meters beneath the surface. "Look," I said, "I'll tell you exactly what old lady Maynerd did to land me in the soup: that'll explain what futures are. In this case, titanium futures."

"I know what titanium is: something they mine and ship to Earth. The last time I looked through our assessment records there were thirty or forty asteroids registered with City

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Hall that we'd leased titanium mining rights to."

"Right. Some of the processed ore is refined and used here in the Belt to build our own spaceships and for other high-temp applications, but most of it is shipped to Earth. And that's where futures come in. Titanium is like any other crop or ore or commodity—potatoes, pork bellies, gold, silver, wheat, anything at all that goes up and down in price depending on the supply and the demand. When there's lots of titanium the price goes down, when there's lots of demand the price goes up."

"Yes, I think even the mayor of our fair city could follow that."

"Good. Now, anyone at all can go out and buy a ton of titanium. If you wanted it for delivery today, you'd pay today's price. But suppose you wanted it delivered to you nine months from today, about the time it takes a pod of processed ore to get from here to Earth—how would you know what it would be worth then?"

Isabel stared down at the bubbles in her Campari-soda. "I don't know. How *would* I know?"

"You wouldn't—you'd *guess*. You'd say to yourself, just like that hyena Bo Wivvel kept saying by vu-mail to old lady Maynerd, there are seven new fusion plants under construction in China, on Earth. They're going to need lots and lots of titanium for the titanium-ceramic fusion chambers.

"You'd also say to yourself that there's lots of titanium on Earth's Moon, but recently there's been a big legal squabble about which country or group actually owns the largest production area. There's been sabotage, there's been litigation, and production on the Moon has almost come to a halt.

"And you'd also say to yourself that the three main Belter companies that mine titanium have recently been working marginal asteroids that haven't panned out as well as they hoped. So production is down, both here and on the Moon.

"So finally you'd say to yourself, and I quote, 'Nine months from now I'll bet that the price of titanium as delivered on Earth is going to be at least twice what I can buy it for today. Therefore, in order to make a nice little profit for myself, I'll go long on titanium futures.' "

"*Long* meaning . . . ?"

"Meaning that you—or Granddame Maynerd—has agreed to *buy* X number of tons of titanium ore for delivery precisely nine months from today at an agreed upon price that will not change no matter what the actual price is nine months from now. We say that the person who sells the ore at that price nine months in the future has gone *short*."

"But how does old lady Maynerd—"

"Make a fortune by going long? Because she'll never actually take delivery of that ore nine months from now—when, remember, she thinks the price is going to be more than what she paid for it today. Instead, she'll sell it to someone on Earth for a big fat profit without ever having seen it. And she'll be making an even bigger profit because she's been able

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to buy her futures on 90 percent margin. Which means that by putting up nothing but a million buckles, which is precisely what old lady Maynerd did, she was able to buy futures for *ten* million buckles worth of ore. So that in nine months, when she sold the ten million for thirteen or fourteen million, she would have made three or four million in profit with an investment of only one million."

Isabel stared at me as if I were a genie who had just escaped from a bottle. "But if it's as simple as that, why doesn't *everyone* do it and get rich?"

I uttered a harsh, guttural sound. "Because there can be certain minor pitfalls in futures trading, as Granddame Maynerd has just found out. Just after she bought her own futures on March 26th, for instance, a little company over on Vesta called BioEats developed a brand new variety of virophage for dissolving the molecular bonds in the carbonaceous rock in which you find titanium ore. It was such a great new virophage for isolating titanium that the yield of titanium per kilo of rock almost doubled. That means that all the asteroids with marginal traces of titanium can now be mined at a substantial profit. Which means there's already a lot more titanium being shipped to Earth than anyone would have thought possible before BioEats's announcement. Which means that the price of titanium began to drop as soon as the news came out."

"Oh my," said Isabel, looking thoughtful.

"Yes. Then all the squabbling parties on the Moon unexpectedly got together and patched up their differences and resumed full-scale production. The price of titanium went down some more. Then China announced that they were only going to build two power plants instead of seven. The price collapsed."

"Which means . . . ?"

"That the shipments of ore that will be in orbit around Earth nine months from the day Granddame Maynerd bought her futures are almost halfway there. On the day her contract expires, December 26th, she is going to have to fulfill its terms and turn over the rest of the ten million buckles she agreed to pay."

"But that *does* mean she'll be the actual owner of X tons of titanium, doesn't it? So what has she actually lost?"

"She'll be the owner of X tons of titanium all right, but the titanium is in Earth orbit and she's here on Ceres. You tell me: is she going to ship it back to Ceres and store it in her living room until the price goes up again?"

Isabel rubbed the side of her nose. "I suppose not. That means she'll have to sell it on Earth at whatever price she can get?"

"Right. And right now, if she sold it today, she would receive exactly 3.72 million buckles. Which means that on an initial investment of one million buckles she has cleverly managed to lose a total of 6,280,000 buckles. Not bad for four months' work, even if she did have Bo Wivvel advising her every step of the way."

"Well, if she thinks Bo Wivvel is so smart, why didn't she lose all her

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money using *his* firm instead of yours?" demanded Isabel indignantly.

"Good old-fashioned loyalty. She said she wanted to stick with the firm she'd been doing business with for forty-four years."

"So that *you'll* go to jail instead of this awful Wivvel person!"

"We always knew that life was unfair." I swallowed the last of my Pernod. "Your turn to buy the next round. But I wouldn't *go* to jail if I could only get that damn computer to—"

"Sorry," interrupted Isabel, "you'll have to buy for both of us—I'm broke."

I stared at her. "Broke? How can you be broke? Payday was only two days ago, wasn't it?"

"Yes, but I wasn't paid, none of us upper echelon types were. City Hall is broke too, in fact all of Clarkeville is broke, or so close to it as makes no difference. We're trying to keep it out of the news, but I doubt if we'll be able to much longer."

"Broke?" I repeated. "How can City Hall be broke? Don't I pay enough—"

"Taxes? No, you don't. You pay some, but not nearly enough. The population's growing faster than we can find new revenues. For one thing, the city's royalties from mining licenses have fallen off, not just on titanium but on all of the other ores, even nickel-iron. And that damn ceresquake is proving to be about six times more destructive than we thought at the time: we're still discovering new problems with indirect damage caused by the quake—today's floods in your office and that missing waiver of old lady Maynerd's are perfect examples. And none of the insurance companies on Earth are paying off the way they're supposed to. We're owed billions of buckles, but just when we'll get them nobody knows. Our credit rating is so low that we can't sell any paper anywhere in the Solar System except at 27 percent interest." Isabel gestured at the mountains of garbage that befouled Westlake Park. "You know that the recyclers are on strike; next week the transportation workers walk out if they aren't given a raise. After that it'll be the engineers at the power station." She leaned forward and lowered her voice. "According to my own calculations, the city is going to run out of money in precisely twenty-three days. And in twenty-four days the emergency loan we got from Pallas—arranged through your pals the Three Blind Mice, by the way—has to be paid off."

I shook my head in a daze that wasn't entirely due to Pernod. "I didn't know there *was* an emergency loan."

"We've kept it a secret, that's how bad things are. But pretty soon we're going to have to pay it off. Only we can't." Isabel shook her glossy black bangs dismissively and forced a semblance of a smile. "So buy me another drink, Johnnie boy, and we'll drink to twenty-three days from now when I'll *really* be out of a job. Or maybe instead you can give me a stock market tip that'll make a billion buckles for all of us—including City Hall."

I scratched my chin and stared off at the mounds of garbage bags, and

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finally leaned forward and lowered my own voice to a fine conspiratorial whisper. "Kidding aside, Isabel, just how desperate *is* City Hall?"

"Kidding aside, dear friend, we'd throw our grandmothers into the city power plants for reaction mass. And *your* grandmother too, if we could get the old lady to stand still."

I scratched my chin some more. "Hmmm. Maybe I have got an idea. Can you get us a ship to take us out to one of the mining asteroids?"

"Which one?"

"Doesn't really matter. Whichever one is closest, I suppose. As long as it's one that sends at least some of its ore directly to Earth."

Isabel shrugged. "Well, I suppose so—what's one more unpaid bill run up by City Hall? Now how about that last drink? Valérie-France will be waiting for her dinner."

The beltship was a four-person vehicle with bright red Department of Citizens Service markings. It was a luxury model the city must have bought while its credit was still good. Neither of us was required to be even an apprentice pilot in order to take it out by ourselves: we merely told it where we wanted to go and it did the rest.

Now, a little more than a million kilometers from Ceres, the two of us were drifting about in the cramped office of Xhosa Xanchu, chief engineer for Magnus Mining's ore block #827/G384. The office was little more than a pressurized tank anchored to the ore block by an expansion bolt jammed into the surface of its 17-percent nickel-iron rock. Eventually, of course, when the biologically tailored virophage had finished chewing its way through what had once been solid rock, there'd be nothing left of this partial hunk of asteroid but a hundred thousand tons or so of closely compacted dust and sand floating through the cosmos. And the office would be floating right along with it.

"But," said Xanchu, "naturally we don't wait for the entire block of ore to be phaged. We activate the virophage on each of the five other sides of the block and just as soon as it starts breaking down the molecular bonds we move in with electrostatic precipitators to separate the nickel-iron dust from the rest of the junk. By the time it's finished and all the rock beneath this office has been phaged, we've got about 20,000 tons of raw nickel-iron to one side and all the rest—about 107,000 tons we figure on this particular job—off on another."

"And you just wrap up all this stuff in big plastic bags?" asked Isabel. "That's *all* you do to it?"

"Sure. What else would you suggest? We double-wrap the nickel-iron, get a governmental seal and certification of purity on it, strap on a couple of low-thrust boosters and some beacons and start the pod on its way to the refinery—or to Earth."

"What do you do with the rest of the rock?" I asked out of pure curiosity.

"Either leave it floating in its plastic wrapper or introduce another type of virophage into it to break it down again for any leftovers that might be

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worth mining—gold, silver, copper. Sometimes there's a lot, sometimes there's nothing."

"And the reason you can't use virophages for mining on Earth or on the Moon is that it's too difficult to segregate the raw ore?"

"That's right, there's too much potential risk of the virophage getting out of hand. Even though the biochemists say they've spliced in a DNA timer gene that only allows the virophage to reproduce a set number of times, it's still best to be careful. Out here in the Belt we can just shove a whole block out into empty space a million kilometers from nowhere—that's why our mining costs are so low and how we can compete with Earth."

I drifted over to one of the room's small portholes and looked out at the star-filled blackness of the sky and at the tiny piece of barren rock to which we were temporarily anchored. This particular ore block, I'd already learned, was of standard commercial size, a fifty-meter cube that had been licensed from Clarkeville Mining Authority, then cut out of the mining face of the 600-meter-long motherlode asteroid and towed the prescribed two kilometers away. Like everyone else in the Belt, I knew it was a capital offense to use a mining virophage any closer than that to any other celestial body, no matter how small. There hadn't been any executions in my own lifetime, but in 2247, three years before I was born, sixteen people had been airlocked as retribution for the Parnegi-6 disaster that had reduced an entire inhabited asteroid to drifting molecules. Since then miners and biochemists had been very, very careful indeed with their pet bugs.

"And all this nickel-iron that goes to Earth," I said, "this . . . this *incredibly* valuable cargo, just goes sealed up in this transparent wrapping like a great big bag of dirt?"

"Sure," said the mining engineer, "in a pod, how else? Once it's in Earth orbit, they wrap it up in their own heat-proof stuff before they send it down for splashdown. But none of that concerns us here."

"No, I suppose not," I murmured. "Come on, Isabel, I think we've seen enough."

"You have?" muttered Xanchu, surprised at our short stay. "Say, you *still* haven't told me what you're doing here."

"Not much," I said, "just checking out an idea I had."

There was a life-size, seminude statue of Abner C. Clarke, the founder of Clarkeville, in a heroic pose in the rotunda of City Hall. It was made of nine semi-precious elements mined in the nearby asteroids. The right arm that gestured so nobly starwards had been cast entirely of titanium. Six days after our return from ore block #827/G384, the news media carried numerous images of the Mayor of Clarkeville staring in bewilderment at a pile of titanium dust on the statue's base, all that remained of Abner C. Clarke's right arm. A leathery-faced onlooker who identified herself to the cameras as a former miner, was quoted as saying that it looked as if

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the arm had been eaten away by a virophage—except, she added, everyone *knew* that virophages only dissolved raw materials, never their refined product.

Two days later, the hardware that automatically archived all communications to and from the offices of the Clarkeville Mining Authority recorded an ultra-narrow beam sent from the vicinity of a tiny asteroid some three and a half million kilometers from Ceres. The panicked voice on the beam identified itself as Shimon Rand, a licensed prospector and miner. He was, he said, merely testing a little bit of that latest kind of virophage for mining titanium when he discovered that not only was it tearing apart the molecular bonds of the asteroid's carbonaceous rock, it was also turning to dust everything else it touched, including the landing gear and communications antenna of his beltship!

"Help!" pleaded the voice of Shimon Rand. "You've got to help me! I think it's started to phage the hull of my—"

At that point the communication broke off.

City Hall checked its records. A miner named Rand had just finished a stint with ExtraOres, a company that had recently begun mining titanium with the new virophage developed by BioEats. Rand had been fired for drunkenness and had not been heard of since.

The mayor of Clarkeville personally assured the directors of BioEats, ExtraOres, and the three other mining companies that had been shipping titanium to Earth for the past two months, that he would do everything possible to smother the story until additional information was available. And he swore that no one in City Hall would ever even *think* of mentioning a word of what had happened to anyone on Earth.

Somehow, however, rumors began to spread.

One commodity trader whispered to another that the self-destruct gene had gone bad, that any titanium cargo shipped to Earth after the introduction of the BioEats virophage was apt to be declared contaminated goods by the Terran authorities, thereby denying splashdown to the entire shipment. Which meant that rather than suffering from a glut of titanium, the market might well be prepared for a shortage.

The price of titanium futures began to rise.

Speculation mounted that the cut-rate virophage developed by that second-rate, hole-in-the-rock company on Vesta might actually have jumped from an ore block back to some of the mother-lode asteroids themselves.

The price of titanium futures doubled.

The rumor leapt to Earth. Earth declared loudly and unequivocally that it refused to let any cargo of titanium of *any* date of provenance come within three million kilometers of Earth orbit for fear of possible contamination by mutated virophages. Any shipments currently en route would have to be tracked down, put in a path that would take them away

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from Earth, and then be closely inspected. After that, they would be decontaminated if possible or, more likely, consigned to destruction by being directed into the Sun.

The price of titanium futures tripled.

At this point I had a short, satisfying conversation with Granddame Maynerd, whom I no longer bothered to call by the honorific.

"Ms. Maynerd? You now have a paper profit of 2.3 million solid gold Belter buckles on your titanium futures. It is time to sell."

"But I'm waiting for them to go hi—"

"*It is time to sell.*"

"But that nice Mr. Wivvel has me going short on the account I opened with him. I'll make some money on your account but I'll lose—"

"IT IS TIME TO SELL!"

Even over the deskphone, there must have been something about the glint in my eye and the baring of my teeth that convinced her. She gave the order to sell.

Half an hour later Earth announced a total embargo on all goods shipped from the Belt. The entire commodities market collapsed and the price of titanium delivered on Earth tripled yet again. I later heard that this was the moment Granddame Maynerd and Bo Wivvel were forced to cover their short positions in titanium futures by buying whatever they could find. Granddame Maynerd was said to have lost 14 million buckles in the process and Wivvel himself a more modest 756,000.

* * *

Granddame Maynerd is still one of the richest women in the Belt. Bo Wivvel is learning to refine nickel-iron ore in debtor's prison. And Granddame Maynerd is suing the Three Blind Mice for everything they have.

There were, however, a couple of moderately happy endings to the story.

First, I got my job back with Hartman, Bemis & Choupette.

The other one Isabel and I discussed over Pernods and Campari-soda at the Café des Mondes. Isabel was treating with a portion of the five-figure bonus for "meritorious service" she had received on her last paycheck.

"They never did find Shimon Rand," she said. "Or his beltship."

"Must have got eaten up by that mutated virophage," I suggested.

"A lot of people who lost a lot of money in the crash are saying that he never existed. And that the mutated virophage never existed either. They are very unhappy."

"That's the danger of listening to rumors and then trying to play the market: you can lose lots of money."

"But they didn't find anything wrong with any of the titanium shipped to Earth and now the price is right back where it was when old lady Maynerd wanted to throw you in prison."

I sighed, then took a long swallow of Pernod to wash down my daily gravity pill. "I *warned* her to stay away from futures. But City Hall did all right on them, I believe?"

Isabel grinned. "Yes, I believe we made over two billion buckles, espe-

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cially when we also shorted all the virophage stocks and all the mining stocks on the market. Then bought them all back just before they started coming back again. The city's paid off all its debt, given raises to all its loyal workers, and even has some money left over to defend itself against the three thousand lawsuits that have been filed against it for unethical speculation."

I raised my glass and clinked it against Isabel's.

"See?" I murmured contently. "That's what you get from dealing with an *ethical* stockbroker." ■

IN TIMES TO COME

Just about anything that most normal people would see as a danger to be avoided whenever possible, *some* folks will see as a challenge to be sought out and tackled head-on. That's why there are mountain climbers and white-water river rafters. Some dangers, of course, seem *too* extreme for recreational use. No one, for example, would willingly sky-dive in a hurricane—or would they? Not now, certainly; but then, some mountains and rivers were also considered beyond human capabilities—until humans developed the right kind of technology to help them. What might that be for hurricanes, and what kind of people would want to use it? Take a look at next month's lead novelette, "Hurricane!," by Bud Sparhawk, with cover by John Maggard. . . .

Elsewhere in the September issue, Hayford Peirce continues his look at the future evolution of human rights after the development of the time scanner, and Mia Molvray's fact article looks at something new and enigmatic in the sky: gamma ray bursters. We'll also have stories by Tom Ligon and G. David Nordley; and, of course, part two of Spider and Jeanne Robinson's four-part serial *Starmind.*

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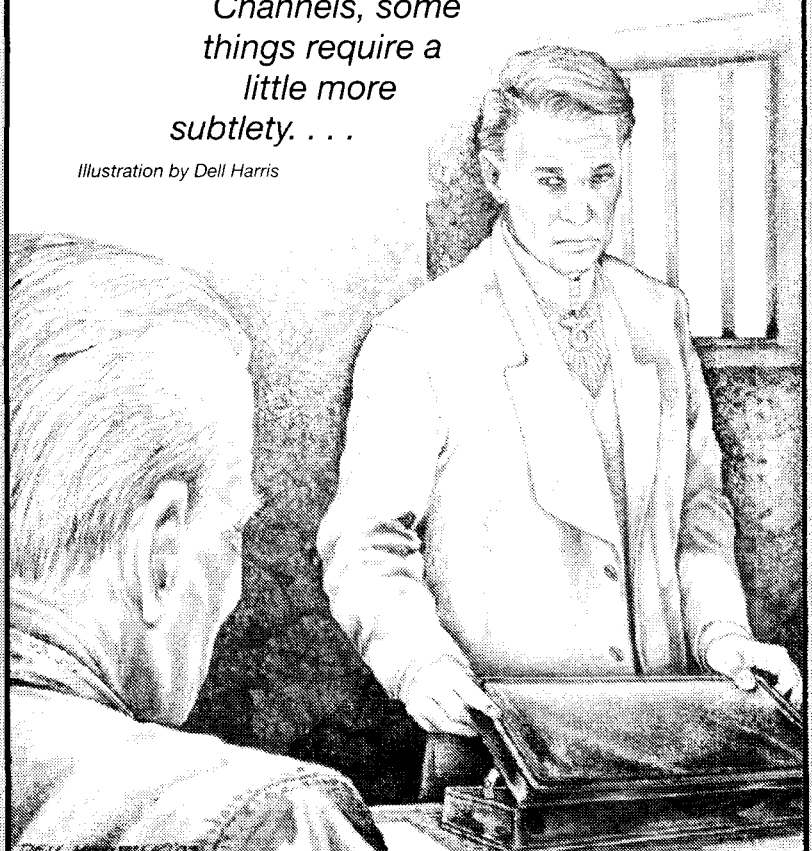
Joseph H. Delaney

THE LUCK OF THE DRAW

Even if you think everything should be done through Channels, some things require a little more subtlety. . . .

Illustration by Dell Harris



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It was one of those oppressively humid days where the air was still and the promise of relief from the thunderheads that loomed on the horizon was still an hour or more away. My clothes were sodden and my feet hurt from tramping all over the downtown area scattering cards. It was time for a rest and a cool drink in the quiet of my new office.

I paused to take a long look at the window before unlocking the door. The twenty-four carat gold-lettered sign had cost a small fortune, a fortune I didn't yet have, and maybe never would acquire if events of the past week were any indication. A week—that's how long the office of Rex Anwalt, Attorney-At-Law had been open for business.

Only—there hadn't been any business. Beyond an occasional curious rubbernecker hardly anybody even looked at my storefront window, and those who did had obviously not been in need. I had taken brief encouragement when, on opening day, a strange little man had taken a notebook from his pocket and stopped to write something down, but except for me nobody had ever yet been inside—unless you counted the mailman, who had delivered the bill for telephone installation also on opening day.

For the first couple of days I had crouched behind the door between the reception area and my private office, peeking through the crack and counting the people who walked by, still hoping that something would happen. Before long, Uncle Joe's prophetic words, the words he had uttered when I told him I meant to study law, began to echo through the stillness. "It's dog eat dog these days. Not like when I started, when law was still an honorable profession, when lawyers didn't have to steal to eat, and when a colleague's word was good."

If Uncle Joe hadn't retired and moved away things might have been a lot easier for me. As it was, I didn't have the cushy spot to move into that I'd been hoping for. I wouldn't regard myself as a defeatist, but, considering how the first week had gone I was getting a little bit discouraged. That was why I'd spent the afternoon like I had, out beating the bushes to get noticed. After all, nothing was happening back at the office, and if somebody did call, the computer could schedule an appointment easily enough, all dates were open.

Suddenly, I noticed the red light flashing on the terminal. There *had* been a call; wouldn't you know it, the minute you go out something like that happens. I fumbled in my pocket for the key, found it and jammed it into the lock, all the while cursing my luck. For days I'd sat around hoping this would happen.

Reason took over and I realized it was foolish to worry. After all, with my kind of luck it would be a wrong number anyhow, just as it had been the only other time the telephone had rung.

"Computer—play the message!"

There was a beep, followed by a pause, then that inevitable electronic buzzing. "Mr. Anwait, this is Daria Coons, Judge Westergren's coordinator. I have an appointment for you.

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His name is Richard Thompson and he's charged with murder. He's in custody and you can see him at the jail. First chance you get I'd like you to stop in and sign an appearance. He's already been arraigned." The electronic noise stopped.

I was stunned. I knew who Thompson was, of course, everybody did; he was the man who discovered the oil bush. He was worth millions, he could easily have afforded to hire the best in the business. So why was Judge Westergren appointing somebody like me to represent him in a murder case? It didn't make sense, there had to be some kind of mistake.

I glanced at my watch. It was 3:00 P.M. The LED on the phone monitor was still lit, and showed the call had come in at 2:52 P.M. I'd just missed her. There was still plenty of time to hop over to the courthouse and sign the appearance, look at the official file and see Thompson before the sheriff cut off visiting to feed supper. I locked up again and hurried over there.

The courthouse was drafty as a barn, with the air conditioning on full blast. My wet clothes were beginning to feel uncomfortably clammy now, but I didn't expect to be in there very long. Ms. Coons had Thompson's file on her desk, anticipating I would want to see it. I signed the appearance for her and sat down in a chair in front of her desk to look through the file.

There wasn't much in it. Thompson hadn't yet been indicted, he had been arrested on a J.P. complaint and warrant. Bail had been denied. I went over the complaint carefully, looking for a mistake and finding nothing. Basically, all it said was that Thompson had intentionally or knowingly caused the death of Alejandro Gonzalez by shooting him with a gun, but that was legally sufficient to charge murder.

I knew the drill from there. Professor Tinker had pounded this into our heads for a whole semester. I could demand a hearing on probable cause, but I also knew that would be a waste of time because the D.A. could get him rearrested even if the magistrate turned him loose, simply by taking it back to the grand jury and getting him indicted. I knew the reason that hadn't already happened was that Thompson had just been arrested day before yesterday and the D.A. simply hadn't had time to schedule a grand jury meeting.

I left the file on the coordinator's desk and went over to the jail, where they made me show my bar card. While I was fumbling around looking for it one of the regulars walked right past me without even being stopped. I wondered how it must feel to be that important.

Eventually they let me in and I rode the elevator up to the fourth floor. The door opened to reveal a guard inside a cage. He would be my next challenge. "I'm here to see Thompson," I stuttered, hoping that might impress the guy.

Evidently it did; his jaw dropped and for an instant he was speechless. He recovered quickly and shoved a card to me through the bars. "Fill this out and sign it while I get him.

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You can wait in the visiting room." He pointed to a closet-sized room across the hall.

I went in and waited, nervously rehearsing what I would say when I saw my very first client. I still hadn't decided what would sound best when he came waddling out just ahead of the guard.

The orange coveralls and the rubber sandals were both an ill fit and Thompson didn't look anything like the man whose picture I'd seen on the evening news the night before. That picture had obviously been from the T.V. station's file and way out of date. This man was some five or six years older, and perhaps thirty pounds heavier.

I introduced myself and invited him to sit down on the other side of the tiny table.

"What's all this foolishness, Mr. Anwalt? If I wanted a lawyer I'd hire one. I don't need you, I'm guilty and that's that."

I cringed. "D-don't say that, somebody'll hear you." I gawked around at the guard. I couldn't tell whether he heard it or not, but I sure didn't want him to hear any more, so I slammed the heavy steel door shut tight.

"What difference would that make? I already confessed."

"Maybe we can get it suppressed, I . . ." I never finished the sentence. I couldn't believe that anybody with Thompson's credentials would do anything that stupid. He was supposed to be the dean of the molecular biologists, with an I.Q. some place up there in the stratosphere.

"You haven't been paying attention, young man, I said I didn't need you and I don't. I know you probably mean well, and I admire your enthusiasm, but I'm a dead duck. I killed that skunk Gonzalez for the very good reason that he needed killing and I'm prepared to take my lumps for it. It's as simple as that."

I stiffened. Back in law school the professor had harped on that very point. A lawyer's job is not just to win, but to make sure everybody gets due process, and due process meant he should get the advantage of each and every constitutional guarantee. I intended that Thompson should get due process, even if he didn't want it.

So I started parroting what I'd been taught. I spent the next twenty minutes lecturing this man on the fine points of constitutional law, trying to make him understand why the judge appointed me and why it would be better for everybody if he let me do my job.

He listened patiently, and I was sure he understood every word, so by the time I was finished I was satisfied with the job I had done and was totally convinced I had won him over. Throughout my lecture he had said nothing. Now he seemed to agree that I had a part to play in this drama.

"I guess maybe I'd better tell you the whole story, Mr. Anwalt. By the way, did you say our discussions were privileged?"

"Yes sir," I replied confidently. "Whatever you tell me is totally secret, uh, with a very few exceptions, and I can't repeat any of it without your prior consent. Furthermore, I

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can't be compelled to reveal what you tell me."

"What are the exceptions?"

"Well, mostly, they deal with communications that promote crimes or fraud. If I knew, for instance, that you intended to offer perjured testimony in the case I'd have to tell on you, but this is the only important exception in criminal cases."

"I see. Does that mean I can tell you the details of my crime and you can't repeat them to anybody else?"

I gulped, then answered. "Yes, it does."

"Motive too?"

"Motive too," I answered. "B-but you have to understand that guilt isn't the only issue in a criminal trial. You also have punishment to consider, and even if you're guilty—"

"I understand all that, Mr. Anwalt. I want you to know I'm not a total ingrate, I do appreciate that you want to do your best on your first case—"

"How did you know that?"

'The guard told me you just got licensed. Stuff like that gets around in a place like this, you know."

Thompson reached over and grabbed my wrist, so that he could look at my watch. "Chow's in thirty minutes," he said, "such as it is. We'd better get on with it."

"Yes, sir." I pulled out my recorder so I could make a record.

"None of that, Mr. Anwalt, not even any notes. Otherwise I will not utter another word. I only agreed to talk to you for your sake. Do you understand that?"

I had no choice, so I nodded.

"I'm no spring chicken," he began. "When I was born Herbert Hoover was president. The first phase of the war to end all wars had been over for fourteen years, and the man who was to provoke the second phase had not yet taken power in Germany.

"Edison had just died, but many of the other scientific and industrial giants were still around. Orville Wright and Henry Ford and Harvey Firestone, to name a few. Einstein had not yet come to this country. Enrico Fermi was a young whippersnapper like you. There were giants all around me.

"There wasn't any such thing as molecular biology in those days. I started out where the oldtimers like Luther Burbank and George Washington Carver, who incidentally was also still around, had left off. For most of my career my methods hadn't changed all that much from theirs. These guys were solid researchers and they developed good techniques."

He paused, apparently to savor this reflection on happier times.

I couldn't yet tell what he was getting at, but he was in control, and if I wanted to hear anything I had to listen to all of it.

"Times changed so much during my lifetime," he continued. "We went from national optimism to national gloom, from a land of inexhaustible resources to a land of scarcities, from a nation of exporters to a nation of importers, from an oil glut to an oil crisis. During my lifetime man first realized that while he could not yet destroy the planet he was fully capable of destroying himself.

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"This is why I decided I had to do something to change that. I did it, and it was working, but Gonzalez didn't care about the world. He was a cowardly little man with a puny little intellect and all he cared about was how much money he could get for what he knew. This is why I killed him, Mr. Anwalt."

"Gonzalez was blackmailing you?"

"He was trying to. I didn't give in, as you can see. I shut him up for good." Thompson's voice sounded absolutely icy, totally out of character with the civilized man he had been before.

"I-I don't know much about him, Dr. Thompson, except they said on TV he was from Venezuela."

"He worked for me at one time, Mr. Anwalt, but it wasn't in a scientific capacity. He was the helicopter pilot I used on my expeditions into the rain forest. I hadn't seen or heard from him in almost five years. Then, suddenly, last week he turned up right here in town. He wanted money."

Thompson paused again. "Tell me, Mr. Anwalt, how much do you really know about me?"

"I've seen the movie they made about you," I answered truthfully. "Then, of course, there's what I heard on TV and what I read about you when you were arrested. They say that when you discovered the oilbush you changed the course of history, and I guess you probably did."

The old man's face now had a distinct smirk on it, as though regardless of what he had done he was daring the world to hate him for killing Gonzalez. It didn't take long for the significance of that look to sink in, and in that instant I thought I had him figured out.

It wasn't supposed to work that way, I knew. Nobody was supposed to get a break from the law because of who he was; everybody was supposed to get equal treatment. But I was a realist. I knew that in practice famous people did get treated better and poor people were treated worse.

I felt a little sick when it occurred to me that Thompson thought his fame dispensed with the need for a lawyer, that he confidently expected the law would go light on him because of who he was.

But in one reckless, nonchalant utterance, he destroyed my theory. "I didn't discover the oilbush," he said.

That remark sent my mind reeling. My carefully evolving explanation collapsed.

The discovery of that bush down in the Amazon ranked among the miracles of the ages. In one fell swoop the discovery of this prosaic-looking plant had not only eliminated the world's energy crisis, it had stopped the devastators of Earth's rain forests in their tracks.

A new theory sprang up to fill the void. "A-are y-you trying to tell me that somebody else discovered it? Was it Gonzalez? Was that why he was blackmailing you?"

Thompson's face had lost the smirk. Now he was deadpan and serious. "I wish it was that simple. The truth is that what has happened already is bound to cause exactly the same kind of speculation you just made, and that could be disastrous. If

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I stood trial, even if I didn't testify, things would be enormously worse. I wish you'd try to understand that it's not only better for me but better for the world that I plead guilty and go quietly away to prison. I won't be around that much longer anyhow."

I was determined not to let it go at that. "As your lawyer, Dr. Thompson, I'm obligated to respect your wishes as long as I consider them to be in your best interest legally." I tried to sound firm.

"But," I added, "I can't determine what your best interests are unless I know the unvarnished truth, and I don't. You say, for instance, that you didn't discover the oilbush, and I gather from that statement and from the fact that you were being blackmailed that Gonzalez was claiming he did. . . ."

"Nobody did." Thompson's face was solemn and grim.

"B-but I remember—from the movie, the helicopter landed and you jumped out with this bundle, and you said—"

"Some actor said it. And yes, I know this is really the way it was, but it was all staged. Gonzalez was just a mope, an airplane driver, somebody to get me around the forest, somebody to interpret for me. I paid him well for that, well enough so that he should have kept his mouth shut."

It was maddening, waiting for the old man to make his point. I knew he must have one, he was completely methodical in every other way. I asked him point blank, "If it wasn't you and it wasn't him, who did discover it?"

"I told you, son, nobody. Nobody discovered it. I made it, in my lab, right here in Texas, and then I took a bunch of them down to Venezuela and planted them all over the place. That's what Gonzalez was threatening to tell everybody."

"You *made* the oilbush?"

"Yeah, I made it. Well, it's true that in a sense I did discover it, but then it didn't look anything like it does now, and it didn't produce much oil—and I didn't get it from the rain forest. I found it growing in a swamp in North Carolina."

"Why the big production about Venezuela, then?"

"Because solving the world's oil crisis would merely have aggravated other problems without some additional compensations. Fossil fuels were already under an enormous pressure from environmentalists because they raised carbon dioxide levels at the same time when the principal consumers of that gas were being reduced. I decided that if I altered the former and not the latter the net effect would be oblivion, so I developed the oilbush as a tropical plant.

"That wasn't easy to do. In fact, it'd be much more efficient and productive if grown in groves like oranges are. I purposely made it extra sensitive to ultraviolet. That way, changes in the level of UV would hurt it more than any other essential crop and the best place to grow it would be under the rain forest canopy."

"I see." I didn't really. To me it sounded like a cock and bush story.

"I'm not convinced you do see, Mr. Anwalt. The problem I had then was

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that what I could do, other molecular biologists could undo, and they could do that much more easily if they knew what my original stock had been.

"Even Gonzalez didn't know that, but he did know that no precursor of the oilbush had ever grown in the rain forest and no mature plant could be found there anytime close to when I claimed my discovery. I knew that if any *real* expert was to pick up on that idea the whole thing would crash."

Again, Thompson's face became grim. "The best way to see that this doesn't happen is to keep my murder of Gonzalez strictly personal, let the world think exactly what you thought—that I stole his discovery. After all, there is precedent for that, because often in the past it's been the old, established scientist who got credit for the discoveries of subordinates.

"Let the world think this is what I did. That way maybe nobody will ever find out where the real oilbush came from, and maybe the people who are trying to break the monopoly of the tropical countries will be a while longer taking this away from them. Let the people of this world remember how it was with rubber back in the last century. Let them speculate, no—let them fear what might be just around the next bend of the river, waiting for them to discover.

"The way things are now these countries are making a bundle off the oilbush. Their people are happy out there in the jungle tending little plots under the big trees. At the moment, the shelter of the rain forest is worth more to them than either the lumber in the trees or the minerals beneath them, worth *enough* more so that they can afford to grow oil and import food from countries with climates too cold for the oilbush to tolerate."

The old man was now getting a trifle didactic, I thought. Still, what he was saying was finally making sense, and a lot of sense at that. So long as the big industrial countries needed the fuel to run their cars and trucks and tractors, there would be a market for what the tropical countries produced; and so long as the oil producers had money they would be the primary buyers of the food and machinery and textiles the oil consumers produced. Furthermore, now that they had a grip on their runaway populations and a means of stabilizing their economies, the oilbush-growing countries would also have the incentive to protect other undiscovered botanical bonanzas that the forests presently concealed. There would always be a fear that, as with rubber, the boom could turn to bust overnight.

I had it figured out.

Thompson could tell, presumably from the expression on my face. "Tell you what, son," he said calmly, "you just let me lead the way, while you take care of the technical details. See to it that I get to plead with as little publicity as possible, and let it go at that. I know what they're going to do with me already."

"Y-you do?"

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"Sure. You think I haven't been smart enough to copper my bets? Let me ask you this, Mr. Anwalt. If you were the state of Texas, and you used to be the kingpin of the national energy industry but now you get almost all your fuel from some other country, and you knew that it was only a matter of time until somebody like me cracked the secret of temperate cultivation, what would you do with me?"

"P-put you to work in a lab someplace under minimal supervision and hope you cracked it before somebody else did. After all, you're not likely to repeat your crime."

"Exactly."

"But you'll never quite make it, will you?"

"Wrong. You see, I already have. I did it years ago, simultaneously with my development of the tropical variety. You see, I do have a sense of civil responsibility, Mr. Anwalt. I couldn't take a chance that my country might also be blackmailed by unscrupulous and irresponsible leaders of producing countries. That's happened before, with petroleum-producing nations.

"This is where you can really do me some service. All the details are locked up in my safe, and I want you to take charge of them. I don't need to remind you that I'm a wealthy man, Mr. Anwalt, and I promise you that if you do follow my instructions and keep my secret you'll never miss a meal."

I was stunned. Basically, what the man was asking me to do was to con the whole world. Aside from ethical considerations there were practical objections. I wasn't altogether certain I was up to it. "Let me think about that for a minute," I said.

It didn't take that long. Thompson was right, I knew that almost instinctively. Nobody with a monopoly can be trusted not to get greedy and squeeze the customers. In time, ambitious national leaders would overspend their national incomes and go into hock with international bankers, and the bankers would certainly be tempted to goose up the revenue even if the growing countries didn't. Natural petroleum couldn't take up the slack if that happened; there wasn't enough of it left anymore, and what there was was far too valuable as chemical feedstock for the world's plastic industries.

That left no alternative. Somebody 100 percent trustworthy and utterly reliable had to take charge of this thing and look after the welfare of the human race. There was only one person I had that much confidence in, and that was me.

"OK, Dr. Thompson," I answered finally, trying to sound thoroughly overawed with the idea, "I find myself compelled to agree with you."

"Good. Now, about this court appointment thing, that looks a little awkward. Is there any reason why I couldn't just hire you to take care of my plea?"

"None that I can think of."

"Good, that's settled. Suppose you get busy and work up a retainer agreement. Naturally, I'll need somebody to take care of all my business interests while I'm locked up, so why

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not you? Uh—except for the technical stuff, like patents. I've always wanted to set up a research foundation but I never had the time for it before. Now that it appears I will have time on my hands and somebody with enough youth and ambition to get it done, there's no reason to put it off any longer. That'll also insure that there'll always be somebody who can launch the temporate strain, if it's necessary, and even if I'm dead."

I gulped, but couldn't talk. The words were in my head but I couldn't get my tongue interested in saying them. The way things had been, up until this afternoon, this development was absolutely miraculous.

Finally, after a long silence I managed to find my voice. "I'll try to live up to your expectations, Dr. Thompson."

He looked at me very sternly for long moments before he said another word. "I know you will. If you don't, I'll tell. As I understood you, the lawyer-client privilege is mine alone to claim, and while what I did was not really illegal it will infuriate some people. You're making yourself my accomplice, you know."

"I know," I replied. I knew he wasn't really threatening me. Had I thought otherwise I would simply have gotten up and walked out. What he was really doing was testing me, trying to raise my temper. I also knew that chance alone had given me an opportunity anybody else I knew would kill to get. I was not here because I was brighter that the rest, or more honorable, or for any other noble reason. It was simply the luck of the draw. I understood Thompson very well, and I knew that compared to what he had personally risked I was risking almost nothing. Our Earth, I said to myself, is worth that much, and I hoped our mutual luck would hold. ■

It usually takes me more than three weeks to prepare a good impromptu speech.

Mark Twain

Remember always that you have not only the right to be an individual, you have an obligation to be one.

Eleanor Roosevelt

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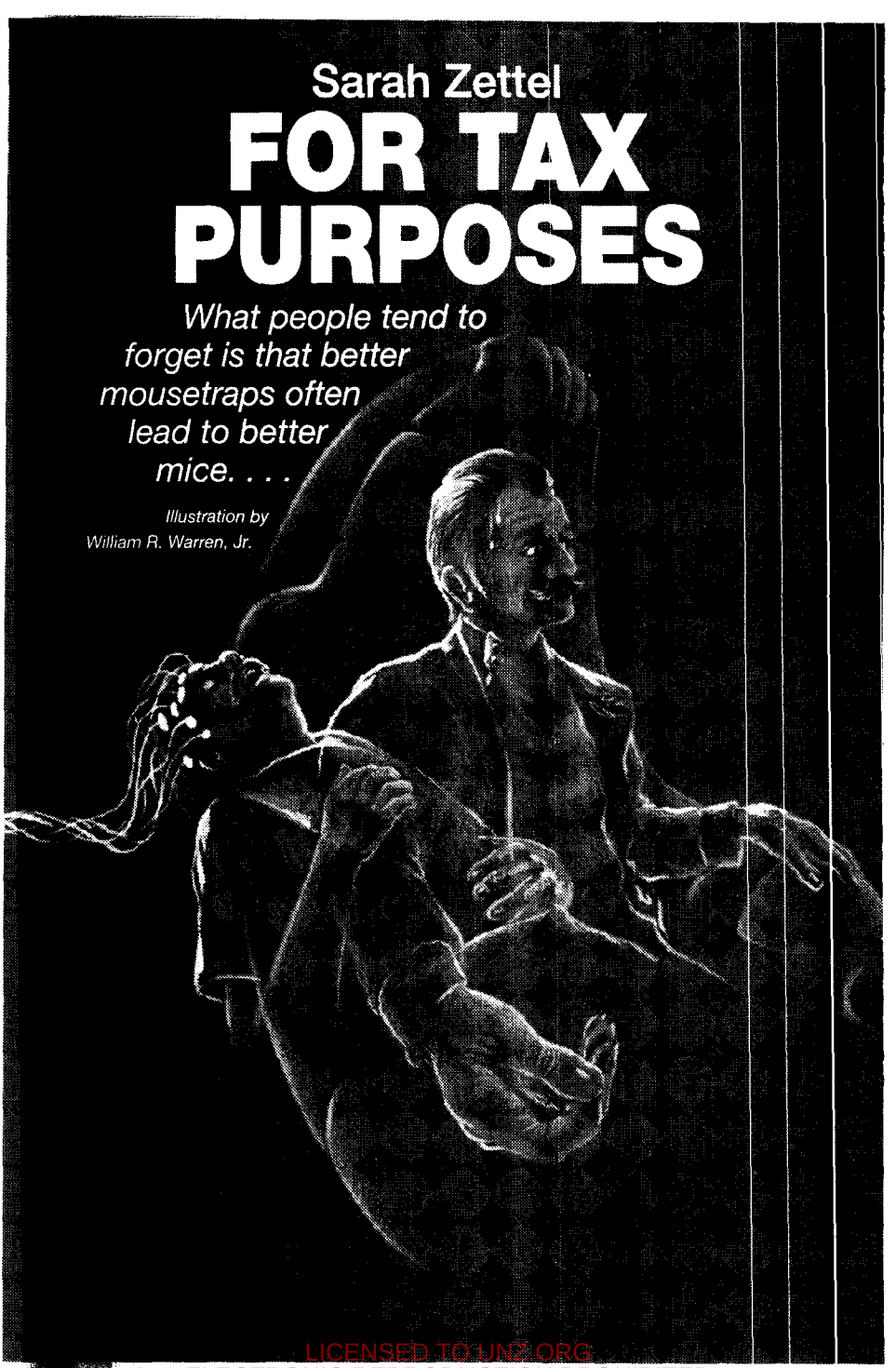
Sarah Zettel

FOR TAX PURPOSES

What people tend to forget is that better mousetraps often lead to better mice. . . .

Illustration by William R. Warren, Jr.



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"Ms. Fowler, defrauding the Internal Revenue Service is still a serious offense." The last IRS employee in the Chicago district drew his shoulders back and tried to put some fire in his voice.

The woman on the other side of the video screen wasn't fooled or impressed. Her voice remained as precise as the cut of her suit. "I posted my acquisition of a dependent according to regulations, Mr. Burns. This entitles me to a reduced rate of witholding."

"As of last year, Dale Rivera," Burns glanced at his desk top where a flat screen displayed the pertinent data, "was forty-six years old and earning a full income as a private investigator. What is your justification for claiming him as a dependent?"

"If you bothered to do your research, Mr. Burns, you'd know." Ms. Fowler leaned forward and touched her own keyboard. The screen flicked to black.

Zedekiah Emmanuel Burns the Fifth slumped as far backwards as his orthopedically correct chair would allow and rubbed his eyes.

God, I miss paper.

Kiah opened his eyes. Nothing had changed. The afternoon Sun still tried to stream through the windows at his back, but was caught in the filter layer so as not to cast any glare on the series of screens and keypads embedded in the circular, artificial-wood desk. The pale grey wall that divided his office from his living room still carried the sign reading PEOPLE WILL NEVER BE OBSOLETE.

Kiah wasn't sure why he kept that sign. He certainly didn't believe it.

The first Zedekiah Emmanuel Burns had made his way from Ellis Island to Michigan and got a job with General Motors. Every Zedekiah after him had worked in the same plant, until the automation revolution sent the assembly line the way of the dinosaur.

Kiah's clearest memory of his father was of him hunched on the sofa the day the last manned line shut down. He could still see veins standing out on the backs of his permanently crooked hands.

"You're goin' to school, Kiah Five. You're gettin' yourself a job with the IRS. Whatever else happens, there's always gonna be taxes."

Kiah Five had done as he was told. His father had lived to see him become a senior investigative agent.

Then, the First World Economic Treaty abolished hard currency. Computer networks handled all transactions. Monetary exchange became a matter of instructing the computer to deduct an amount from one account and simultaneously add it to another. Each transaction was sent to the treasury department system, which categorized the exchange and measured it against the records of the participants. The computer deducted the proper amount of tax from the appropriate party's account. All dubious transactions were referred instantly to the Federal Bureau of Investigation. If anyone had a problem, they could take the US government to court, a proceeding which seldom worked out for the plaintiff, since the government still had more lawyers

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than anybody else.

The Change Over had allowed President Aubrey to all but abolish the IRS, a move which won her the next election. A skeleton bureau had been left behind to deal with emergencies. The term "tax time" vanished from the vocabulary. Kiah kept his job on the basis of seniority—barely.

After a few weak protests, he resigned himself to a life of dealing with things the automated systems couldn't handle, like misspelled names, forgotten ID numbers on record updates, or the occasional question about withholding status.

For a brief moment, today had looked like it was going to be different. Kiah had walked into the office to find the message UNABLE TO NEGOTIATE TRANSACTION blazing in red on his main screen. His heart had been in his mouth as he lowered himself into his chair. His finger shook as he touched the return key.

What? What is it? Some cracker try to get into the treasury lines? Somebody try to change their status through a back door? Visions of Al Capone's sneering face danced in front of his mind's eye. *Did somebody actually try to duck the automated systems?*

The first few lines of information sobered him up part of the way. There weren't any gangsters or crackers. A woman named Louisa Fowler (ID number 013-84-0129-0) had declared she had acquired a dependent, a mature man named Dale Rivera (ID number 408-19-6314-7), without even declaring him to be living with her.

Faced with either the most blatant case of fraud since the Change Over, or with a major typing error, Zedekiah Emmanuel Burns the Fifth, duly authorized investigative agent of the Internal Revenue Service, placed a call to Ms. Fowler's home, which was also her workplace, and was told to go away.

What made it worse was the fact that she had been right. He should have at least checked some background of the situation, if only to find out why she tried to classify Rivera as a dependent and not a POSSLQ—Person of Opposite Sex Sharing Living Quarters.

Kiah swiveled his chair around to face the windows. There were still plenty of people around who remembered when the IRS had been a terror comparable to the Spanish Inquisition. They found endless delight in avenging themselves on its remaining human representatives. Ms. Fowler was probably one of them. She had the right look in her eyes. She was probably chuckling over the idea of the balding agent trying to work out her typing error.

Well, even if it is a wild goose chase, it's something to do. I'll go talk to Marian.

A small rack on the desk held his virtual reality gear: a shiny black visor that looked like a pair of wrap-around sunglasses with earmuffs attached, and two thick gloves. Light and sound dimmed as he settled the goggles over his eyes. The gloves were a little too small for his thick fingers. Kiah fumbled for the pre-set key on the

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desk top, and pressed it.

His office vanished. Mahogany shelves crammed with books engulfed him. Kiah's imagination supplied the smell of dust and old paper. Directly in front of him stretched a wooden counter piled with books to be checked back into the library. Behind it, a slender woman in a stylized, nineteenth-century dress took notes from a massive dictionary. She smiled at Kiah and straightened up.

"And what can I do for you today, Mr. Burns?"

At one point, Kiah had been in love with Marian. He'd seen a psychiatrist about it, until he'd started falling in love with her and she suggested he go back to the simulation.

"I need the background records on Louisa Fowler and Dale Rivera." He gave their ID numbers. "Specifically, I need to know their current tax and living status and why Ms. Fowler is trying to claim Mr. Rivera as a dependent, if you please, Miss Marian."

Marian's pencil flew across her pad. "I'm sure we have what you need. If you'll excuse me a minute, I'll go look this up." She flashed him another smile and disappeared between the shelves.

Kiah's heart flipped over and he sighed at the reaction. Nothing but a computer program based on a musical he'd never seen. Marian wasn't even the whole program, she was just the interface. As soon as he had stated his question, the program had determined which databases would need to be accessed and wrote a series of sub-programs that the software engineers called "knowbots." Each knowbot scurried to its appropriate destination, bridging whatever protocols lay between Kiah's central processor and their goal. If necessary, the knowbots wrote their own smaller knowbots to help out. The other nickname for the program was a "flea generator."

Once the outside database had been contacted and the data request relayed, the information would be poured into Kiah's home unit, where it would be sorted and reshaped to answer his question. Supposedly, the program could access any public database and, because Kiah still had authority as an IRS investigator, a large number of private ones as well. He'd never had cause or curiosity to put the thing to any real test.

Most of this request was nothing special. The information about Fowler and Rivera's status could be taken directly from the database housed in Kiah's own desk. But to find the reason why Fowler tried to classify Rivera as she did, that would take something close to human inference. The program behind Marian would have to extract separate facts from disparate sources and reassemble them to make something new. The computer would, in essence, make a deduction. For all that he had an irrational attachment to the simulation of Marian, she was also the reason he no longer believed the motto hanging on his wall.

Marian reappeared carrying a sheaf of papers. "Here you are, Mr. Burns." She deposited them on the check out desk. "It seems Mr. Rivera does not actually live with Ms. Fowler, but she

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is supporting him completely."

Kiah scanned the pages in front of him. The gloves on his hands allowed him to act as if he were picking up old-fashioned, handwritten pages. He savored the illusory touch of the paper against his finger tips.

Louisa Jane Fowler, information retrieval consultant. She owned both the rooms she lived in and the ground they stood on. Kiah turned a page to display her average annual income. She could certainly afford it. She'd managed her one-woman business well. Her income had tripled in just the last year. She'd had a marriage, a divorce and two different POSSLQs. The second had been Dale Rivera. He'd moved out fourteen months previously. All changes in status had been promptly reported.

Kiah turned another page. Rivera's records were also in good order. The private investigator had made good, if sporadic, money. He'd been a husband three times and a POSSLQ twice before his luck had run out. An elevated train had derailed last February with Rivera inside. He had become one of the eighty-four victims the news networks described as "severely injured."

Kiah shuffled through the police reports, hospital records, the initial doctor's prognosis, and the second and third opinions. The extra work had been solicited and financed by Louisa Fowler, but nothing had helped. Rivera's spinal cord had been severed. By the time they'd gotten him out of the wreckage and to the hospital, there hadn't been enough left of his nerves to re-stimulate. Grafts had failed. He was completely paralyzed and bedridden for the rest of his life and his insurance had been canceled a month before the accident for non-payment of premiums.

Louisa Fowler had taken pity on him. She'd had him moved to a specialty-care clinic. The bills for round-the-clock medical support and supervision were astronomical. Marian had tallied up some of what Fowler purchased to keep Rivera alive and comfortable: physical therapists, virtual reality programs, delicate hardware that could respond to the flicker of an eye, which was all Rivera could manage on his own.

"Please put all this on my desk, Miss Marian." Kiah lifted off the goggles. His office surrounded him again. He pulled the gloves off and rubbed his temples. The files he had leafed through in the library now glowed on his screen. All in order, waiting for his authority to begin proceedings to declare the forty-six-year-old man a dependent.

I'd be creating a whole new class of dependent, Kiah thought, trying to work up some enthusiasm. *With my name on it. It'd be a chance to earn my pay, for a change.*

It was irregular, because Rivera did not live with Fowler, which was why the system hadn't been able to handle it, but if the payments she was making on Rivera's behalf did not qualify him as a dependent, Kiah couldn't have said what would. Without even insurance, Rivera could not be said to be generating any income. The thing to do was pass the whole situation to

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Greg at the Washington office. The three-person legal department would give it a good going over and Greg would pronounce a judgment. Probably not favorable. Greg did not like people. Fowler would probably have to be declared Rivera's legal guardian before she could try again.

Something old kept Kiah's hands from moving; a vague unease left over from the days he spent poring over paperwork and his old VDT, back when everybody who deliberately left something off their forms had themselves convinced they were Robin Hood. He'd caught a few of those paper outlaws then. More than a few.

But that was before the networks, knowbots, and the credit system—when the system depended on people for information and they could still lie. Now the computers report them every time they make a move and there's not a damn thing they can do about it.

Kiah leaned forward and accessed the index listing of all the files Marian had put on his terminal. Yes, Louisa Fowler's tax history from before the Change Over had been included. With two keystrokes, Kiah brought it up for display.

A single line explained his discomfort. Fifteen years ago, Louisa Fowler had been investigated by the IRS under suspicion of tax fraud. Nothing had been found. The investigation had been conducted by Zedekiah Burns the Fifth.

An information retrieval consultant and a private investigator. If anybody could cheat an automated system. . . .

He shook his head. *You're daydreaming, Kiah Five. Transmit the files to D.C. Go back to the living room. Rent "The Untouchables" and forget it.* He looked up at his sign again. *And quit being stupid. Of course Rivera's really in that clinic.* Kiah scanned his empty desktop. There was nothing on his IN screen. The message light on his phone system was dead. The room offered no options to another day of putting in his time and waiting for something to happen.

Impulsively, Kiah brought up his post-Change Over contract on the desk screen.

"Authority to investigate any changes in status that the automated systems are unable to reconcile," he read to the empty room. He thought about Louisa Fowler's eyes and about the good old days when there'd still been paper on his desk. Kiah got to his feet.

It's something to do.

The Oliver Sacks Clinic for Neurological Traumas was a white and glass building nestled in the middle of the most carefully groomed lawns Kiah had ever seen. He had to explain himself to a receptionist, a duty nurse, and a long-nosed doctor before he finally got to speak to Dr. Kiawis Marshall, the floor supervisor.

"Anything I can do to help," Marshall announced after he had checked the credentials on Kiah's pocket computer. "I understand these things have to be done by the numbers. Actually, I'm impressed." He dug his hands into his lab coat pockets.

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"We've gotten so used to computers and virtual reality, almost nobody thinks to go check the physical facts anymore. Mr. Rivera's been with us for a year. Ms. Fowler keeps him in fine style, may I say. If anybody deserves a break, she does."

The "physical facts" turned out to be a private room with a picture window that let unfiltered sunlight flood the room. Dale Rivera, a pale, gaunt man despite the supervisor's glowing description of the care Louisa Fowler bought him, lay in a bed that looked more comfortable than the one Kiah slept in at home. A brace held his head straight for the virtual reality mask covering his eyes and ears. Threads of optical fiber ran from his arm to the plastic box of the bedside computer. An IV dripped down a tube into his other arm. His chest rose and fell rhythmically under the sheets, but other than that, he was as still as a corpse.

"Mr. Rivera can hear and understand voices, of course, but he can't talk without help." Dr. Marshall beamed at the mask. "Virtual reality has done a lot more than make pretty computer games."

Kiah tried to keep his eyes on Marshall. If he stared too long at Rivera, he knew he was going to be sick or start shaking. "I imagine Ms. Fowler's a regular visitor."

Marshall shook his head. "Never. I try to encourage the families to come down and physically be with the patients, but she won't do it. Says she can talk to him better through the networks than she can standing here, so why come?"

"The networks?" Kiah exclaimed. "He has access to the networks?"

"Of course. Ms. Fowler purchased a knowbot program for him. It uses a virtual reality interface too—"

"Yes, yes, I know the principle." Now, Kiah looked directly at Rivera. The blank, black mask looked back. "So, I could call him up?"

"Of course." Kiawis's eyes narrowed. "Is there a problem, Mr. Burns?"

Kiah remembered Louisa Fowler's hard eyes and her history. "Maybe."

Back in his office, the message light blinked fitfully from the phone pad. The display said the call came from the D.C. office. Kiah touched the callback sequence and waited for the video screen to flicker into action.

The scene that greeted him was not pleasant. Gregory Seabrook was a red-faced man under normal circumstances, but when he saw Kiah his skin flushed to the color of a third-degree sunburn.

"I really hope you're got something concrete going on there, Kiah." His voice strained to the breaking point. "Because I've got a Louisa Fowler threatening lawsuit and publicity to get rid of you, me, and what's left of the IRS unless you get her change of status processed."

Kiah's spine wanted to wither. It had been too long. He'd forgotten what it was like to actually pursue a case, especially when there was nothing to go on but hunches. "Greg, I've got a private investigator who's permanently attached to a hospital bed but who still has access to the networks.

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Fowler's an information retrieval specialist who's trying to get him declared her dependent without going through formal proceedings, and," he leaned forward, "her income has tripled in the last year."

Come on, Greg, put it together. Please. Please, God, let him put it together.

Even through the video screen, Kiah could see the light that sparked in his boss's eyes as the possibilities unfolded for him. Greg's skin faded to its normal shade. "Can you get me evidence?"

Kiah's shoulders sagged. "I don't know. I don't even know if there's really anything going on. It's a funny situation, though. I mean, they're both network experts . . . I suppose, technically, we ought to turn this over to the Feds."

Greg laid both hands on his desk and looked Kiah square in the eye. "Kiah, as your supervisor I am officially telling you the FBI doesn't need to be bothered with this. The system hasn't kicked out anything, it's just found a new situation. You are to investigate that situation and make a recommendation. I can probably get you seventy-two hours to do it. If you find anything. . . ." He smiled. "If you find anything, Kiah, we're back in business."

Greg cut the connection, leaving Kiah facing a blank screen and his own thoughts. He'd known his supervisor for years before the Change Over. He was one of the kind that gave the IRS its reputation. He liked the power. Wrong: he loved the power. The demolition of it had nearly killed him. He still went to AA meetings. If Kiah could prove it was still possible to cheat the computer system, then he'd be bringing Greg back his glory days.

Kiah looked up at his sign. *Is that what I want? My power back?* Kiah shifted his weight and ran his hand across his scalp. *No. I just want to be useful again.*

He swung himself around and put the virtual reality gear back on. Marian's library surrounded him. She was still at the desk, still taking notes from her dictionary.

She smiled at Kiah and straightened up.

"And what can I do for you today, Mr. Burns?"

He felt his thoughts force themselves into old motions, like rusty gears. "I need to know the type of cases Louisa Fowler's been taking, and how many there have been."

"I think we still have her records out, Mr. Burns." Marian flipped open a ledger on the desk. "Yes. Right here." She passed him the book.

Kiah ran his finger down the page, his eyes flickering between the columns. No appreciable increase in the number of clients. That would have been too obvious. There had been a substantial increase in the fees she was commanding, though. Kiah flipped a page to the summary of Fowler's work history. Apparently, the fees had jumped because the complexity level of the jobs she was taking on had jumped too. Instead of just repairing crashed CPUs and tracing misdirected credit applications, Fowler was performing extensive

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data searches in the most chaotic regions of the Internet. Kiah's eyes widened. She'd even helped the FBI break a whole ring of high-level crackers. The bounty on that job could have paid Rivera's expenses for a year.

He set the book aside, leaving it open to the account summary page. Marian was still smiling at him.

"Let me see the phone company records for Dale Rivera. I need to know who he's been talking to since his accident."

Marian's pencil flew across her pad. "If you'll excuse me a minute, I'll go look this up." She flashed him another smile and disappeared between the shelves.

Kiah fidgeted. *It can't be this easy. If I find anything from this, it'll be that I'm wrong. These two are specialists. They wouldn't leave anything intact for me to find.*

Marian returned with another ledger. "Here we are, Mr. Burns," she passed it to him.

Kiah flipped through the records. Public library. Louisa Fowler. Pay-Per-Use Entertainment Services. Public Library. Louisa Fowler. Louisa Fowler. Public Library. Public Library. Louisa Fowler. Louisa Fowler. Louisa Fowler.

Kiah looked up at Marian. "Can you get me transcripts of any of these conversations?"

"I'm sorry, Mr. Burns. I can't do that. Privacy regulations, you know." The smile turned apologetic.

"Of course." The FBI could subpoena the records, but that would mean trying to turn this into an official criminal investigation and at this stage, there was no guarantee Kiah could make the Bureau listen to him. They might just see a frustrated little man chasing his old glory at the expense of the last genuinely charitable woman on the face of the Earth. She had probably really loved this Rivera character before cruel fate had made their reconciliation possible.

Kiah drummed his fingers on the check-out desk. "Can you get me a rundown on what he was doing in the library files?"

"I'm sorry, Mr. Burns, I can't do that either." Her smile didn't change.

"Well, what can you do?" Kiah muttered.

"I can compare the amount of time Mr. Rivera spent on-line with Ms. Fowler to the timing of each of her banking transactions with her clients."

Kiah yanked his head around. He hadn't expected an answer, much less a useful one. But then again, that's what Marian did, wasn't it? Compared and contrasted data and came up with new ways to arrange it.

"OK," he said, "OK. Let's see that."

Marian produced another sheet of paper. "Here you are, Mr. Burns."

The page showed a neatly plotted graph. Rivera's strings of calls to Louisa Fowler occurred only when she had no active clients. When she was working, Rivera busied himself with the library and entertainment services.

Which made perfect sense. Fowler was self-supporting. She didn't have time to tie up her communication lines with chit-chat while she was

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working. Either that or, the pair of them were carefully avoiding contact at those times when it might arouse suspicion if someone ever decided to run such a comparison.

Kiah laid the paper down. "Mr. Rivera uses a knowbot program to access the library database, doesn't he?"

"Yes." Marian's smile brightened.

"A knowbot program can do more than one thing at once, right?"

"Of course, Mr. Burns. It's what we're designed for."

"Could a knowbot program access, say, the public library files and from there access other databases, transferring the information through the library system, so the transaction would be kept under the privacy restrictions if anybody wanted to look at it?"

Marian hesitated, her smile faded for the first time in Kiah's memory. "Would this be for the purposes of conducting illegal transactions?"

"Yes, it would."

"Well . . . I couldn't do it, Mr. Burns. Knowbot programs and all their sub-programs have an ID flag, rather like a fingerprint or a DNA sequence. The flag is recorded in the databases they contact along with a record of what information was retrieved, just in case anyone in authority needs to track a transaction."

"Could you write a knowbot program that would create sub-programs without the ID flag?"

Marian's eyes shifted between the shelves and the check out counter. "This is a hypothetical question, Mr. Burns?"

"Yes," Kiah lied.

"Then, hypothetically, yes, I could. It would be illegal of course, and subject the perpetrator to prosecution and probably cause them to be banned from the networks permanently."

That gave Kiah pause. Someone banned from the networks couldn't even make a phone call. He thought of Rivera lying in his bed and staring out his window, for the rest of his life.

Why would he risk that? Just to give Louisa Fowler a tax break? Especially . . . Kiah stopped. *Especially since with a knowbot program and network access he could still be in business for himself. Maybe he wouldn't be living in such style, but still. . . .*

"Miss Marian, I need a record of the knowbot sub-program that left the Chicago public library files while Mr. Rivera had accessed the library. Specifically, I need a complete list of the outgoing knowbots with ID flags that do not match any of the flags of the incoming knowbots. Then, I need the unmatched knowbots traced."

Marian did not frown, exactly, but she looked troubled. "That could take awhile, Mr. Burns. The main branch of the Chicago Public Library handles several million knowbot transactions a day."

"Can you do it?"

"Ye . . . es." she paused. "The trace may not be complete because of privacy regulations."

"Miss Marian." Kiah planted both hands on the check-out counter. "This is an official IRS investigation of possible tax fraud. These proceedings are being initiated on my authority as

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Senior Investigative Agent for Cook County. You will do what I asked. And while you're at it, you'll find out if Mr. Rivera, the private investigator, ever caught anyone capable of writing that hypothetical, illegal program we discussed. Is that clear?"

Marian flashed her brightest smile. "I'm sure we have what you need. If you'll excuse me a minute, I'll go look this up."

The virtual reality interface for Rivera's phone system showed Kiah a perfect reproduction of the hospital room he'd walked into two days before. Instead of a corpse in a bed, however, Kiah faced a long-bodied man seated in a comfortable armchair in front of the window. He took a moment to admire the detail in the simulation. It was probably directly responsive to Rivera's voice patterns and would adjust the facial features to match them.

"Hello, Mr. . . . Burns," Rivera greeted him uncertainly.

"Thank you for agreeing to see me, Mr. Rivera." Kiah's simulated self sat across from Rivera. He folded his hands. He had practiced this attitude back when he was still a junior auditor. It radiated calm. He had liked to try to keep his interviewees calm, even when he had to explain what their audit had uncovered.

"I can't think of anything I've done lately that would attract the IRS's attention," Rivera laughed. "I don't even have a bank account. Louisa handles all that for me." He gestured towards the empty bed. "I'm a little housebound these days."

"Not really. You've still got your network access." Kiah smiled. "Must be a real godsend for you."

Rivera sighed. "Yeah, it is. The wonders of modern technology, eh? It's great of Louisa to keep it open for me, even if I can't use it like I used to."

"Oh?" Kiah's eyebrows arched.

"Yeah. I know it doesn't sound like it, Mr. Burns, but I suffered from severe oxygen deprivation in my accident. It caused permanent brain damage. What you're hearing is enhanced in more ways than one. I'm all but hardwired into this interface because I can't even think straight anymore."

"I'm sorry to hear that, Mr. Rivera. I guess that answers my question."

"What question?" Rivera's face tightened.

"Well, as I'm sure you know, Ms. Fowler's trying to have you declared a dependent. It would give her a nice tax break. The whole situation's fairly irregular, though. So before I can recommend a course of action to my superior, I had to check things out. You understand."

"Sure." Rivera smiled without any of his facial muscles loosening. "Sounds like Louisa. If there isn't a straight line between two points, make one."

"Sounds like a difficult person to get along with."

"Oh, yeah." Rivera's gaze strayed out the window. "Next to impossible sometimes."

"I guess that's why you moved out."

Rivera's entire body jerked. "How . . . oh, my records. I forget, the IRS

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still has all that stuff, don't they?"

Kiah nodded. "We still do. Not that we really need it anymore. I guess it's just a habit the bureaucracy developed. Wonder if there's a twelve-step program for it?" They shared the laugh. Rivera relaxed visibly.

"Yeah," Kiah crossed his legs and leaned back. "We don't do much these days, that's for sure, but we still deal with a lot of people. Like, talk about coincidence, I was on the lines with one of your ex-wives just yesterday." He shook his head. "She didn't have much good to say about you. 'Leech,' I think, was her most polite term. She said you sort of lived off her between jobs and then left.

"And I got to thinking, what if that was a kind of habit with you? What if you did that to Louisa Fowler, and then when she heard about your accident, she managed to dish out a little profitable revenge. She set you up so you were looked after and comfortable and then used your skills to augment her business. You'd be paying your own way then, and if she could hide that fact, she could use the expense of looking after you to arrange a substantially reduced rate of withholding. And I do mean substantial. You wouldn't believe the numbers I came up with." Kiah folded his arms. Rivera went back to staring out the window.

"That's of course before you told me about the brain damage. I'm glad you did. I must have missed that in your medical records. I was ready —God, this is embarrassing—but I was ready to accuse Ms. Fowler of all kinds of things. Fraud and conspiracy to commit fraud. Tax evasion. Kidnapping. Coercion. Blackmail.

"See, I thought that someone who knew the networks as well as she does could, theoretically, get into your insurance company's networks and cut off your insurance after your accident, making it look like the company had cut it off before the accident for nonpayment of premiums. If she did that, then she could make a proposition that you come to work for her under her terms. She might even have evidence of some illegal activities in your past, like that you used to be a cracker or something like that. She could have used all of that to blackmail you into complying, because if you were convicted of being a cracker, you'd be permanently banned from the networks, and left in a state hospital, without insurance and. . . ." He shook his head. "That'd be beyond imagining, wouldn't it?"

Rivera didn't move. "Yes, it would."

"I can see you doing almost anything to avoid that. I'm glad you didn't have to, though." Kiah got to his feet and walked straight into Rivera's line of sight. "I don't like what I know about you, Mr. Rivera, but I was going to come here to make a deal with you. See, I thought I'd managed to prove you had access to an illegal knowbot program and that you were using it to generate income for Louisa Fowler. My evidence is pretty flimsy and a good lawyer would have chewed it up and spit it out. Being IRS doesn't pull that much weight anymore." He smiled. "Ms. Fowler knew that, which was why she went

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through us, or why she would have, if she was attempting something illegal. We're small, we've got very few legal powers left, and nobody likes us. It's worse than being a dentist. But if I had your cooperation, well, I could catch Louisa Fowler, expose a weakness in the credit system, and create a new tax category. All of which would be worth enough to the government to keep your network access up so you could go into business for yourself again, free and clear, after paying off a fine and serving probation.

"But of course, that's not how it is at all. So I won't take up any more time. Thank you for talking to me, Mr. Rivera, you've been very patient." Kiah turned away. "Funny how I missed the bit about your brain damage. I'll look again and I'm sure it'll be in my files when I get back to my office. Or I could ask Dr. Marshall for a look at his. Your floor supervisor's an old-fashioned man, you know that? He keeps physical files."

He met Rivera's eyes. They were wide open and staring.

"But . . . they don't make paper anymore."

"No. But a few places do still make microfilm. Good-bye, Mr. Rivera." Kiah broke the connection.

Kiah pulled the virtual reality gear off, settled back in his chair and grinned up at the sign on the far wall. It was going to work. Greg would probably go out and dance in the streets.

The irony of it was that between them, Fowler and Rivera had made a good point. There were probably hundreds of people out there who were not just physically, but mentally sustained by friends and loved ones through the networks. Those people were entitled to special consideration. Network hook-ups cost money.

Kiah rubbed his scalp. *What would you call them? Mental dependents? No. Significant Minds? Brain of Opposite Sex Sharing Living Quarters?* Kiah chuckled and faced his own window. Chicago sprawled across the landscape all the way to the horizon.

"Look out, Mr. Capone," he said to the world outside. "We're back!" ■

He that knows little often repeats it.

Thomas Fuller

A mind that is stretched to a new idea never returns to its original dimension.

Oliver Wendell Holmes

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BIOLOG Jay Kay Klein

Still on the sunny side of 30, Sarah Zettel has managed to call eight towns in three states home, not counting a summer spent in London. With an SF fan as a father, she grew up reading Doc Smith, John Campbell, Robert Heinlein, Isaac Asimov, Poul Anderson, and the other *Analog* authors who helped create modern science fiction. Writing started in junior high, with submissions continuing until a first acceptance at age 20, and finally a story in the December, 1991 *Analog*.

A B.A. in Communications from the University of Michigan led to a continuing occupation as a technical writer doing software systems instructional manuals. Her scientific interests have centered around computers, medicine, materials science, and anthropology. More recently, an intense interest in biology has been sparked by a molecular biologist with whom she authored a short story that has a very long title in the January, 1994 *Analog*. Sarah's first story here was encouraged by editor Stan Schmidt at an SF convention when he said she had a great idea in having a computer virus turn werewolf during the full Moon.

What happens to people and what they do is Sarah's principal concern, as contrasted to the older-style hard SF of straight-tech puzzle. Early on, she felt she might be more adept at fantasy because you'd have to know so much to write SF. She has, however, grown up immersed in a computer-interconnected world unlike anything in previous history. This is creating an entire new culture in socialization and communication that is changing the human condition and habitat.

Just as evolutionary are the new techniques of biomechanics and bioengineering. With gene changing

(Biolog continued on page 126)

Sarah Zettel

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THE ALTERNATE VIEW G. Harry Stine

MURPHY'S LAW REVISITED

Has any reader not heard of Murphy's Law? Has any reader not been a victim of it?

"Anything that can go wrong will go wrong."

Actually, it's not a law. It's an axiom, a self-evident or universally recognized truth or maxim. Too bad it wasn't called "Murphy's Maxim." Sounds better and has alliteration. But fewer people would understand it. ("Maxim? Didn't he invent the machine gun?")

The etiology of Murphy's Law lies in the human factors research of Colonel John Paul Stapp at Edward's Air Force Base at mid-century. Murphy was one of his rocket sled technicians. Murphy was the fountainhead from whose fertile mind the wording of the infamous Law sprang.

As usual, it's yet another great advance in human understanding that has come from technology. Mathematicians have spent nearly half a century developing the basic understanding of why Murphy's Law is so axiomatic. The mathematicians didn't know they were doing this.

The basis of Murphy's Law appears to lie in the evolving mathematical field known as "chaos." (I've heard it referred to as "chaos theory," sometimes with initial capitalization. I'm not certain that it yet deserves to be elevated to theory level. At best, it may be a hypothesis.)

A mathematician colleague of mine remarked to me that he believed chaos theory (I'll give him the benefit of the doubt and call it such hereafter) was an important new step in scientific understanding. The behavior of weather patterns as well as interpersonal interactions in meetings could be better understood, he maintained, with an understanding of chaos theory.

I respect this person's expertise and vision, so I went looking for a way to learn something about this new phenomenon. I found *Chaos: Making a New Science*, by James Gleick (Penguin Books, 1987, New York, ISBN 0-14-009250-1).

Although the book is readable and fascinating, I found myself quickly asking, "So what else is new? Gee, I ran into this first in 1953 at White Sands. Again in the early 1960s when I managed a corporate research

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laboratory."

Basically, part of chaos theory points out that the "second order effects" that you conveniently ignore in order to make the explanation elegant and understandable will come back and bite because they are cumulative. They change the system so it doesn't behave in a clean and straightforward manner. However, chaos theory cannot predict mathematically (yet) what the cumulative results of these second-order effects will be.

The book also convinced me that there may be something to this newfangled quantum mechanics stuff after all. God may not shoot dice with the Universe, but the Deity works to smaller or larger dimensions than we are currently capable of handling. This includes time as a dimension, by the way. Chaos theory may yet lend itself to providing a solid theoretical basis for quantum mechanics. Or even a General Field Theory.

Chaos theory is also a statement of measurement accuracy. Sometimes your instruments simply won't report to the level of accuracy where the second order effects can be seen at all. For example, with the technology of 1924, a mere 75 years ago, the doping of semiconductors could not have been detected with the best chemical analytic devices or techniques of the time. Therefore, as better instruments of more refined accuracy become available, repeating an old experiment such as the classic Foucault pendulum may reveal a totally different result.

It's also a statement that repeats what any engineer or technologist knows: You can't measure and account for every variable that will affect the system. So you design in something called a "safety factor."

The life sciences are certain to be affected by chaos theory. It provides a rationale for cancer as well as aging. All the little second order effects cause breakdown of the systems over time.

Chaos is also a "limits" theory. Again, it echoes what we've known in our guts for generations: A system may perform quite well until you push it beyond some limit. Sometimes, this limit can be predetermined. Often, it cannot because no limit was foreseen (or admitted). Again, chaos mathematics cannot predict what these limits are. Thus far, the limits must be established as a result of experimental data.

Our social organizations are empirical systems that are sublimely subject to chaos theory. It's impossible to control all the variables in a social organization. Anyone who has tried to run a local civic organization knows this very well. Does anyone really wonder why political systems—which are social organizations—appear to be so non-linear and unstable? From this standpoint, chaos theory may have its greatest application if we can figure out the equations from other than an empirical foundation. There is an adage, "When in total ignorance, try anything and you will be less ignorant." Usually, you can get away with this, provided what you do isn't lethal or doesn't lead to an unforeseen lethal consequence.

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This is always the danger inherent in the empirical approach.

We are often forced into the empirical approach to solving problems because we don't know all the variables or because the equation is so gawd-awful messy that it's unusable. For example, anyone who has fiddled with applied fluid dynamics—such as designing or piloting flying machines—runs into an empirical factor called Reynold's Number (which is a variable) and a mind-busting nonlinear partial differential equation that goes by the name of Navier-Stokes. This is a consequence of chaos theory, too.

In fact, I must reluctantly admit that the whole Universe is probably based on chaos theory. Mister Spock will have real trouble with it from a logical point of view. Maybe it is logical in its illogic! Certainly, it is nonlinear. At best, it may be hyperbolic up to some limit. The neat equations that used to be taught in high school physics (but no longer are in some school districts because Newton is a Dead White Male whose work is at the foundation of the Domineering Eurocentric Culture) are linearizations of non-linear equations. They were developed in order to work with the Universe within certain limits, often known but usually unknown. The real world is a partial differential equation in umpteen-zillion unknowns. Even a 486DX with math coprocessor has a little trouble handling them. So does a Cray.

So the real world is non-linear but we treat it as a set of linear elements. What happens when we "push the envelope?"

In the May 1962 issue of this magazine was a science-fact article by Dr. William O. Davis on the "Fourth Law of Motion." It reported on some theoretical and experimental work that was done by the late Dr. Davis, the late Prof. Serge A. Korff, E. L. Victory, and me. It stated that no system could be changed in zero time and that there was a finite time during which the system could not react as a system to any change, internal or external. It was succinctly summarized by Davis's statement, "You can get away with anything if you do it in less time than the system can react and then either leave the system immediately or, in the process of getting away with it, change the system so it doesn't react."

This is pure and simple chaos theory, too. Maybe it will receive some attention after all these years now that it no longer seems so revolutionary.

Inherent in the work, by the way, were the principles behind a non-rocket space drive, the "impulse drive" of Gene Roddenberry's creation, "Star Trek."® Lee Correy also used Davis's work as the scientific basis for his novel, *Star Driver*, published in 1980. (When Professor Korff, professor emeritus of physics at New York University, read it, his comment was, "Well, this is certainly going to muddy the patent situation some day.") Davis's work was done 30 years ago. Perhaps it was "born 30 years too soon." Many breakthroughs (if this was indeed a breakthrough) occur a generation before they are

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reduced to practice. Again, this is a consequence of chaos theory. From a practical point of view, the Old Guard must retire and the Young Turks must come into power. This takes about 30 years.

Chaos theory finds fertile ground in today's engineering work where engineers often place total confidence in computer programs, including CAD. Although recently I've seen a few engineering bullpens of wall-to-wall drafting tables, I tell myself that I'm seeing the end of an era, the demise of an engineering dinosaur. A genuine drafting table is likely to become as much of a valuable museum piece as Sergei Pavolvitch Korolev's slide rule. That relic of the Soviet space program brought $17,000 at a recent Sotheby's auction. (I lusted for it but couldn't hack the price.)

But these modern computer engineers implicitly trust the CAD and other programs they use. The programs are capable of calculating something to as many significant figures as one cares to use. (I used to calculate things to absurdly large significant figures but gave that up when I became approximately 35.7835 years old.) In fact, the computer programs are capable of calculating far beyond the levels of accuracy of any measuring device. A real engineer, of course, operates in the real world. ("Measure with micrometers, mark with chalk, and cut with an axe.")

And if you don't believe this, you haven't tried to produce working hardware in cooperation with the shop.

At the same time I was reading Gleick's book I discovered Henry Petroski's book, *To Engineer Is Human: The Role of Failure in Successful Design* (Random House Vintage Books, 1992, New York, ISBN 0-679-73416-3).

It was all about applied chaos theory, although it didn't put it that way.

Petroski, a professor of civil engineering at Duke University, is the sort of prof that makes an undergraduate engineering course both a Class 3 Tylenol Headache and a joy.

He asks questions such as how simple design errors caused the collapse of the walkways in the Kansas City Hyatt Regency Hotel. Or what made the Tacoma Narrows Bridge twist apart. Basically, engineers didn't account for all the variables, relied on scientific data that dismissed second-order effects, or ignored Murphy's Law.

Maybe it was something as simple as the checker getting the drawing at 3 P.M. on Friday with a note from the chief engineer that it had to be released to the shop by quitting time.

Petroski says that design failures lead to successful designs. I have said something similar in these pages many times before: You really cannot make progress without controversy, without building and testing it in the real world (not the computer), and without the engineering understanding of *how*.

We must be allowed to make mistakes and given the opportunity to correct *those mistakes quickly without being guilty of intolerable wrongdoing.*

Maybe this is additional ammuni-

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tion in the battle to change tort liability laws.

Both books have been real joys to read and re-read. I recommend them to all of you. Behind both of them lies the reality of Murphy's Law and the reason it probably indeed is a law rather than just an axiom. ■

EDITOR'S NOTE: This column is the 100th G. Harry Stine has written for "The Alternate View," a column which he helped launch in 1978. The AV, dedicated to science and technology news and opinion, with a built-in mechanism to insure different viewpoints and encourage thoughtful controversy, is just one aspect of a long and varied career in aerospace technology and both fiction and nonfiction writing. Congratulations, Harry!

(Biolog continued from page 121)

coming up, we may no longer be concerned with our children carrying on—we will be doing it ourselves in person with extended lives. This will force us to make use of the rest of the Solar System if not for living space, then at least for raw materials on an extended scale. We may wind up in space not because of a need for adventure or the sheer joy of seeing new places, but propelled by the corporate greed of strip-mining companies.

A first novel is underway with a plot driven by genetic engineering, biotechnology, personal choices, and interplanetary politics. ■

Why there must be a black hole under my bed:
1. It's very hard to get out of in the morning.
2. Time dilation: In a time that seems to be only a few minutes to me in bed, the clock across the room advances by 8 hours.
3. Warped space-time: It seems impossible to keep the sheets and blankets arranged to keep some parts of me warm, without others getting cold. Some sort of non-Euclidean geometry must be involved.

David C. Humm, Ph.D

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Probability Zero

APPLIED SCIENCE

Lawrence Person

Thirty minutes late, with both his regular parking garages full, Brian Bowery spotted the tiny lot wedged between the liquor store and the adult theatre on his third circle around the block. When he got close enough to see the prices on their sign, he was shocked to find them half of normal New York rates—mere extortion rather than highway robbery. He quickly pulled in, gave the attendant his keys, and set off at a run toward his office. He had gone less than half a block when he realized that his sales charts were still in the trunk.

Bowery rushed back to the lot just in time to see the attendant pull his car into an open spot—

And disappear.

A few seconds later the attendant reappeared in the space, *sans* car.

"Oh, *mother*," said the attendant, watching Bowery watch him. "You weren't supposed to see that."

"How—" began Bowery.

"You'll have to talk to the Doc," said the attendant. "He can explain it better than I can."

A bespectacled old man with frizzled white hair and a wide hula-girl tie peered at Bowery from behind his desk. "Mr. Bowery," he began, "How much do you know about extra-spatial physics?"

"Well, I'm an advertising executive, so—"

"*Nothing*! All right then. When the Universe was just created, itty-bitty microseconds after the Big Bang, all twelve of the forces in the Universe were squished together like a giant matzoh ball. Then, a tinier microsecond later, BOOM! Everything splits and collapses, like the New York real estate market. Lost your shirt on those condos, didn't you?"

"How did—"

"Never mind that now! Anyway, even though we can only see three of those twelve dimensions, those other nine are still connected to our own, and by tunneling through the cracks in the Nth dimensional spacetime continuum, we can travel to worlds where there's lot of space, but no people. That's where we take the cars."

"You mean—"

"Yes!" said the doctor triumphantly, a crazy gleam in his eye. "Parallel Universe Parking." ■

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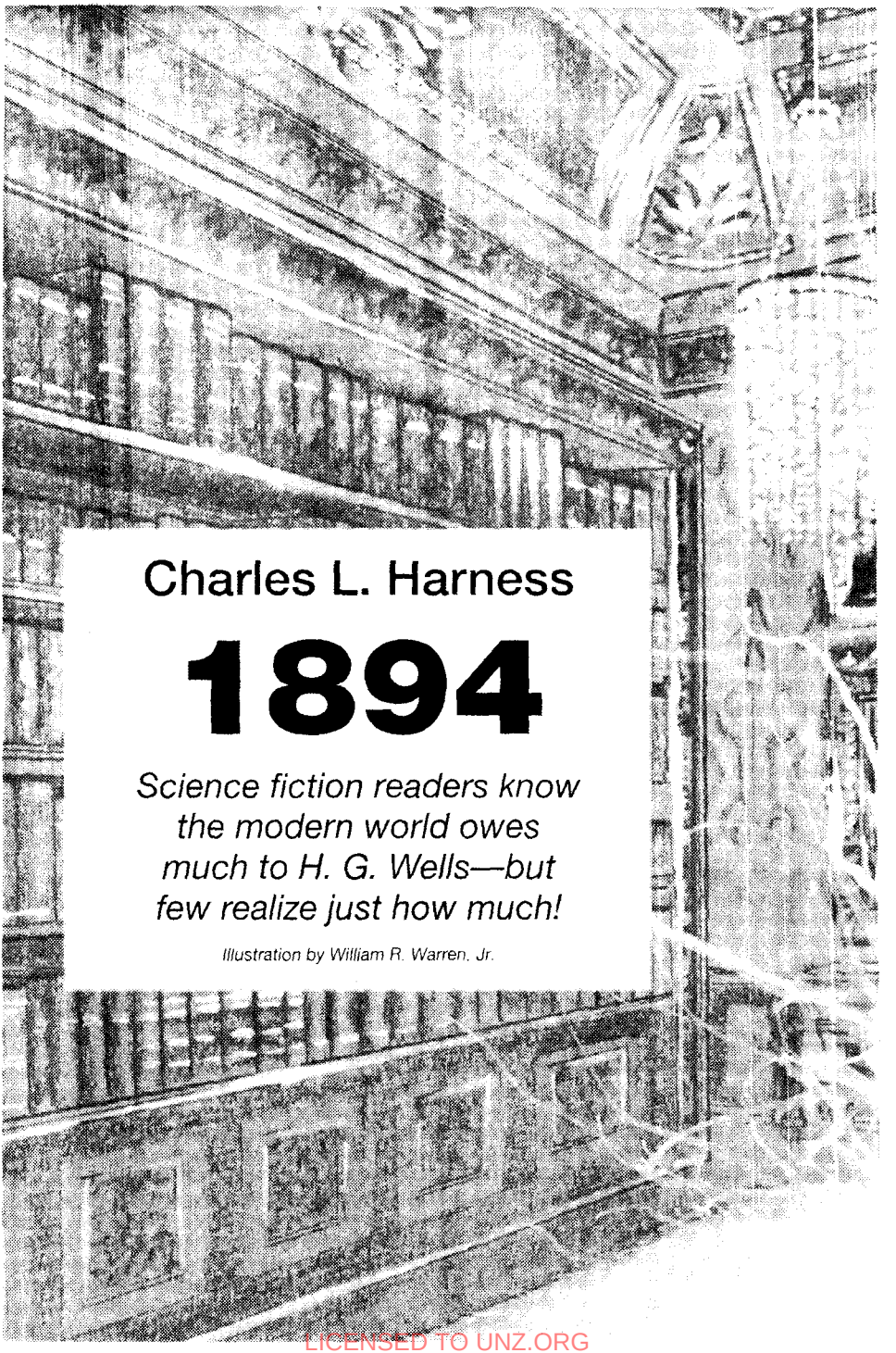

Charles L. Harness

1894

Science fiction readers know the modern world owes much to H. G. Wells—but few realize just how much!

Illustration by William R. Warren, Jr.

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[*Editor's Note: The University of Illinois possesses the most comprehensive collection of the papers of H.G. Wells in the world. The following document is one of the few critical Wells papers never acquired by the University. It is made public here for the first time.*]

1. The Colonial Office

Even as I passed through the doorway I wondered if I had entered the right place.

It was a rather large chamber with a high ceiling and an oversized fireplace with a dying bed of coals. Above the fireplace hung an oversized flag. At first I thought it was the Union Jack. It had the same blue cross bars on a field of red. Closer inspection showed stars within the bars. This was the flag of the American Confederacy.

An officer in a rumpled gray uniform sat at a nearby table. I couldn't quite make out the rank. A colonel as a receptionist? I wondered. The Patent Office must really be an important place!

He held a small glass in one hand and a bottle in the other. He stood as I entered. "Come in, suh, come in! You're just in time to join me in a toast to the second-greatest man who ever lived. Here, I'll pour you a glass." He spoke with an accent, definitely un-British, yet soft and pleasant, and as he spoke an odd thing happened to his face. A bulge in his right cheek vanished and reappeared in his left cheek.

I stared at this phenomenon for a moment, then held up my hands quickly. "Thanks just the same," I said. "A bit early in the morning for me. But tell me, who is this second-greatest man?"

He looked at me in amazement. "You don't *know?*"

"No, sir, I'm afraid I don't."

He lifted his head proudly. "Today, suh, we celebrate the birthday of Jefferson Davis, our first president, born on the third of June, eighty-six years ago." (He pronounced "born" as "bawn.")

That didn't sound quite right. "But today is June 6. June 3 was last Sunday."

"My point exactly, suh. It goes on all week, you know."

I noticed then a dozen empty bottles in and around his desk. "So if I may ask, who was the *greatest* man who ever lived?"

He looked at me in a rumpled mixture of wonder and sorrow, then replied with measured reverence and, "Robert E. Lee, who else?" His eyes seemed to look far away. "Oh, you should have been with us at Gettysburg, when we beat Meade, and swept on to Washington. You come around in January, suh, when we celebrate Bobby's birthday. Last year they had to call out the Home Guard. Nothing like back in Richmond, though." His cheek bulge shifted again. He sighed. "Well, I guess you'd like to get down to business. Your name, suh?"

"Wells," I said hurriedly. "Herbert G. Wells." By now I was certain I was in the wrong place.

He pulled a sheet of paper from a

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drawer under the table and examined it thoughtfully. "Wells? Hmm. Don't seem to see it." He cocked a curious eye at me. "You have an appointment, Mr. Wells?"

"Yes, sir." I handed over my telegram. He examined it briefly, then gave it back. "Oh ho! Well dang my hide, suh. You're looking for the Patent Office. *They's* next door." (He pronounced "door" as "dough".) He pointed. "People always comin' in heah' tryin' to get a patent. I tell 'em, the S'uthrun Colonies are now part of the British Commonwealth and covered by British patents. Son, you don't want to see Mr. Mason. You go next door, they'll help you."

I glanced toward the door behind him that evidently led to an inner office. On it was painted the legend, J.M. Mason, Jr., H.M. Resident Deputy, Southern Colonies.

I knew now where I was. When the American Confederacy established their independence with British help in 1863, they accepted Dominion Status and had their own resident representative in London—in the same building with the Patent Office.

I backed out with mumbled apologies. I had inadvertently run headlong into a bit of history, for the Mason in question was his excellency Mr. James Murray Mason, Jr., son of the famous Mason of the pair of Mason and Slidell, who had persuaded England to recognize the American Confederacy and to back up the recognition with the British navy, arms, and money, lots and lots of money. It didn't end there, of course. While we were thus happily ensuring a continuing supply of cotton for our Lancashire mills, Napoleon III had stepped in. When the dust settled, a lot of maps required extensive revision. The French had annexed Quebec and Mexico. We got the American South—and slavery. The American North survived and prospered.

I was in the act of leaving Mr. Mason's suite when I was given a dramatic explanation of the bulge in the colonel's cheek.

He spat. The target was a gleaming brass spittoon the size of a chamber pot, sitting beside the fireplace, four yards away. It was like striking a gong.

And *drinking* at the same time? I was awed. I closed the door quietly behind me.

Macauley had once argued that the British government had made only two really serious blunders since 1066: Number One, driving the American colonies away in 1776; and Number Two, taking back the southern half in 1863.

And so on down the hall, and this time through the portals of the genuine Her Majesty's Great Seal Patent Office.

2. The Telegram

It had been a strange day, a day of shattered routine. Yesterday, and for many days prior, Jane* and I had scheduled our lives with order and despatch in our two rooms at 12 Mornington Place. Our bedroom had

*Ed. Note: "Jane" was Wells's very personal name for Catherine Robbins. They were living together and would be married as soon as Wells's divorce from his first wife, Isabel, became final.

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a double bed, chest of drawers, wardrobe, chairs, wash basin, and so on. Every morning I jumped out of bed, pulled my britches on over my night shirt, Jane got into her wrapper, and then we'd go through the folding doors into the front room, already warmed up a bit if need be by a coal fire, set by the house servant in the cold dawn. I'd take a look at the paper while we had breakfast. And then we'd both get to work—I to my writing, Jane to her science studies. In the afternoon we'd take long walks, looking for material I could write about. So far in this year of 1894, I have done fairly well. By year's end I'll probably have sold seventy-five articles, and I was off to a marvelous start with my stories: "The Stolen Bacillus," "The Diamond Maker," "Aepyornis Island," "Lord of the Dynamos."

Home from our walk, it's tea and scones, then back to work. Supper is brought up in the evening, and then more work. And finally to bed, and some wonderful love-making as the trains thunder by and rattle the house.

Yesterday that halcyon routine was blasted by a thing that I had set in motion the year before. In 1893 I had applied for a patent on "Temporal Flux Adjustment." At the time I was simply thinking of a couple of articles, with titles such as "The Inventive Act," "How to Get a Patent," "The British Patent Office," that kind of thing. Applying for a patent seemed a good way to start. But there were immediate problems. First, one must have what appears, at least superficially, to be an invention. So, how about my ideas for traveling back in time?

I explained the theory to three patent agents, one after another. Patent agents are special lawyers, and most of them have offices on High Holborn and in Staple Inn, near the Patent Office. They pontificated in buildings erected in Tudor times, with semiexposed beams, plaster, and jutting windows. For each century *en retard* I think they added another £ 10 to their fees.

One after another, they refused to take my case. Also, the cheapest wanted a £ 50 retainer. Ha! So I wrote up the patent application myself, complete with a proper description and drawing of the time-flux modifier, included a postal order of £ 5 for the filing fee, and mailed it off, all without benefit of clergy.

Months passed, and no word from the Patent Office. I tried to conjecture what might be going on in those august chambers. Probably they had read it, passed it around for all to have a good laugh, and then tossed it into the waste basket. Too bad. No articles. And so I forgot all about it.

Then, yesterday—the telegram.

I had been working on a short story. Jane answered the door, and a moment later came bouncing up the stairs, waving a little sheet of paper. She stood at the entrance of our sitting room, and in a trembling voice, she read:

"Wells, H.G., 12 Mornington Place, Camden, London. Re: Application for Letters Patent Serial Number 21-X, filed 3 March 1893, for Temporal

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Flux Adjustment. The comptroller respectfully requests your attendance in chambers at ten o'clock in the morning of 6 June, 1894 to discuss the subject patent application."

I snatched it from her hand and read it myself, carefully, word for word. Yes. No hoax. Only the Patent Office had the filing data. It was real, at least in substance. But the *form* was unreal. A telegram is expensive. The message is generally presented in as few words as possible. But not this one. Look at the extra "the's" and the several unnecessary prepositions. Over half the words were surplusage. *Somebody*—the comptroller?—was spending a lot of money just to make sure there would be no mistake in my instructions. It was all very very odd. I knew for a fact that (1) interviews for pending applications were rarely granted, (2) that when they did occur, the notices were sent by ordinary mail, and (3) the interviews were always before the examiner in charge of the case, *never* before the comptroller.

What was going on?

So, today, I arose early, had a quick biscuit and tea, and left Jane sleeping groggily as I set off for my mysterious meeting with the comptroller. I had earlier decided to walk. The exercise would put me there wide awake. I had a feeling I would need to be fully alert with every nerve tingling.

3. I Walk to the Patent Office

So early this morning, while Jane slept, I set off down South Everholt Street, which changed to Southhampton Street, and then a left turn into High Holborn. (An article, perhaps, on how London streets keep changing their names? Or how they got their names? "Holborn" means "Stream in the Hollow"—the great highway runs along the route of what used to be Fleet River. London sucks up these little streams like a sponge.) Farther down High Holborn is the Viaduct and the circus with Prince Albert's statue raising his hat to the city of London. Albert, born in 1819, died December 1, 1861. The date of his death sticks in my mind because it's part of the sign over the draper's shop where I was once (oh so unhappily!) apprenticed. It's also the date Britain declared war on the Northern States during the American Civil War.

On to Chancery Lane on the right, and Gray's Inn Road on the left. This is Dickens country. Hard by is *The Old Curiosity Shop.* As a lad of sixteen Dickens joined the law firm of Ellis and Blackmore at Gray's Inn, and quickly acquired very definite ideas about lawyers and the law. As he said in *Bleak House*, "A poor man has nothing more to fear from lawyers than from a gang of pickpockets." Again, in *The Uncommercial Traveller:* "I look upon Gray's Inn generally as one of the most depressing institutions in brick and mortar known to the children of men." But apparently not everybody felt the same way. Shakespeare staged *The Comedy of Errors* in Gray's Inn in 1594.

We English love history. A third of the English are busy making it, a third are busy recording it, and a third are busy reading it. A fine market for scribblers like me! Except that *I* want

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to write history before it happens. I want to write of things to come.

I go down to Chancery Lane to Lincoln's Inn, then to Staple Inn, where Dr. Johnson lived for a while. They're called inns because lawyers once lived here. Now they're legal universities, and the seat of the Council of Legal Education. The lawyers have all moved to side streets.

The Patent Office (including—alas!—since 1863 the Confederate American residency) occupies an attractive two-storey Jacobean building on the south side of High Holborn. It is huddled in very nearly the center of London, and hence of course in the center of the world. The main entrance faces Staple Inn, and that's where I came in and encountered Mr. Mason and the American Confederacy.

And now I think I'm finally in the right place.

I gave my name to the lad at the reception desk. I assumed he'd give me directions to the comptroller's office, but for a moment he just stared at me. "Do you have something to identify you, Mr. Wells?"

I showed him the telegram.

"Thank you." He arose, bowed slightly, and murmured in very formal tones, "This way, Mr. Wells."

This both puzzled and alarmed me. I was not accustomed to civility, much less respect, from a government employee. Something very serious was going on. I was torn between an urge to turn and run, and an even stronger urge to stay and find out what it was all about.

I followed him upstairs and down a hall. At the end of the hall was a double door, guarded by four men-at-arms.

Their sergeant stepped forward.

My heart was now pounding away like a trip-hammer. Something was *wrong*, horribly wrong. Was I about to be arrested? Simply for filing a patent application? No. Not yet, anyway.

"Mr. Wells," the receptionist announced to the sergeant.

"Proper I.D.?" demanded the sergeant.

"He has the telegram."

The sergeant clicked his heels together vehemently, bowed, then held the door open for me.

I walked in.

Five people were spaced around a table in the center of the room. One was a woman, the others were men. As I entered, the men rose to their feet.

The woman was small, plump, and dressed in black. Except in pictures I had never seen her before. But I recognized her instantly: Victoria Regina, the Widow of Windsor, Her Majesty the Queen.

Now, I hold no brief for royalty, or for that matter, for the hereditary nobility. I'm a republican. It made no sense to me that *they* should live in the lap of luxury while I and my family had to watch every pence in a hardscrabble attempt to survive.

I now noticed a dark figure leaning against the nearest wall. He was peculiarly dressed, with a long light-colored jacket, black trousers, and a brimless cap. I took him to be the Hindu manservant that helped the queen in and out of her wheelchair

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and carried her up and downstairs. He kept half-lidded eyes on his mistress. The rest of us he ignored. And we ignored him.

So, as I waited for someone to say or do something, I had decided I wasn't going to offer that spine-cracking ceremonial bow you see in the illustrated newspapers, when ambassadors from small unpronounceable countries are presented in court.

Meanwhile, I was trying to place the standing men, and I was having no luck at all. I couldn't even identify the Patent Office Comptroller.

But the uncertainty ended quickly.

The man at the end of the table said. "Mr. Herbert George Wells?"

To him, I nodded slightly. "Yes?"

"Mr. Wells, I am Reader Lack, Comptroller of Her Majesty's Patent Office."

I nodded again and mumbled something inconsequential.

He now turned to the queen. "Your Majesty, may I present Mr. Herbert George Wells."

And now, damn it, I found myself bowing deeply!

She said quietly, with no hint of sarcasm or irony, "We are grateful that you could spare the time to attend us, Mr. Wells." She peered at me rather vaguely, and squinted, as though trying to bring me into focus. This seemed to confirm the gossip: she had cataracts, and was going blind. Not surprising. In this year of 1894 she was seventy-five. She continued, "Mr. Levering, now that we are all here, perhaps you would like to complete the introductions."

"Of course, Your Majesty." He cleared his throat. "Major Banning, Her Majesty's equerry." The officer bowed somberly.

"Mr. Thomas Wilshire," continued the patent official.

To his right a slight gray-haired man bowed slightly.

I blurted, "*The* Tom Wilshire?"

"Sir?" he said.

"Joseph Paxton's lieutenant? Some say *you* invented the machinery for laying the glass panes in the Crystal Palace?"

"A gross exaggeration, sir." But his lips lifted in a faint smile. "I merely carried out Mr. Paxton's instructions."

"And finally," said the comptroller, "Sir Almroth Wright, M.D." Dr. Wright bowed formally.

I knew the name of course. Everybody did. Dr. Wright had developed a typhoid antitoxin. A very new thing, and already a matter of great controversy in the medical profession. The entire army medical corps (which still had strong adherents for bleeding to combat fever and hanging asafetida around the throat to combat influenza) was dead set against it. Perhaps thereby proving it must have merit.

"And now gentlemen," said the queen, "Please be seated." I found myself sitting very uncomfortably directly across from the queen. After the chairs had stopped scraping, she said, "Mr. Lack, you may begin."

4. The Project

"Thank you, Your Majesty," said the Comptroller. "And now, Mr. Wells, since the matter is complex, I

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trust that you will bear with me if I seem to digress from time to time."

I didn't know how to reply to that. I said simply, "Yes, sir."

He continued. "As perhaps you are aware, our patent examiners are generally well educated and are widely read, particularly in their special fields."

"So I understand."

"The examiner in charge of your application has, in fact, followed fairly closely the published literature in multidimensional physics, including your own articles." He opened the file folder that lay on the table before him and lifted out several papers. "I see here your three-part series, 'Chronic Argonauts,' in *Science Schools Journal,* 1888. You explored the rudimentary idea of time travel, and gave us a look at the future. A bit of fantasy, eh, Mr. Wells?"

I shrugged. "We don't really know yet, Mr. Levering."

"Well, let's get on. You revised and rewrote, and we see earlier this year, in *The National Observer,* seven different articles, all unsigned, all dealing with the same materials. Your publications, Mr. Wells?"

"Yes, sir."

"And now we come to your patent application. Am I accurate when I say that, in this one document, you have summarized all essentials for making a machine that will let a man travel in time?"

"I tried to, sir."

"And may we assume, Mr. Wells, that it was not your intent to perpetrate a hoax on the Patent Office, which is to say, a hoax on Her Majesty's government?" He regarded me sternly through his spectacles.

I thought very rapidly. There was something in the rules that said filing a patent application was a good faith representation by the applicant that the invention would work as described. There were penalties for perjury, including jail time. I swallowed hard. "Certainly not, sir. I have not built the machine, but I believe it can be built, and that if and when it is built, it ought to work."

He seemed to relax. "That's good to hear. Now, Mr. Wells, as required by the rules, the core of your invention is stated in Claim One of your application." He adjusted his spectacles. "Let me read it. 'A brass rail frame comprising, in dimension-altering configuration, a sapphire crystal, a plurality of twisted quartz bars, ivory bars, ebony bars, and nickel bars, EMF source, two control levers for forward and reverse time motion respectively, means for indicating movement in time, and accommodation for the user.' " He peered at me over the rims of his spectacles. "Is that an accurate summary of your time machine, Mr. Wells?"

"It is."

And everything was still a great mystery. Whatever was happening was happening because the queen wanted it to happen. But *why?* What was her interest? And Dr. Wright? How was *he* involved? And Tom Wilshire, the supermechanic? I gave a couple of covert glances in the queen's direction, but she remained silent. No answers *there.*

I waited. It was up to these people

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to make sense out of this.

The Comptroller said, "Inventions with possible military applications are routinely brought to the attention of the War Office. To shorten the story a bit, Mr. Wells, the examiner in charge of your application sent an abstract to our military liaison, Major Banning, and he mentioned it, rather casually, I understand, to her majesty, who, it happened, was aware of the typhoid work of Sir Almroth. Dr. Wright, perhaps you can continue the explanation?"

The famous physician took up the tale. "Of course. First, a little background. Prince Albert died of typhoid on December 1, 1861. His illness was quite possibly complicated by an earlier bout of influenza from which he had never fully recovered. Considering his general poor health, taken with the rather limited medical knowledge of the day, there was no way to save him. Today, though, we might have done better. Summed up, I have developed an antityphoid vaccine, which can be administered by hypodermic inoculation. Our preliminary experiments give protection in ten days. To prepare the vaccine, I simply sterilize broth cultures of the bacillus at sixty degrees Centigrade." He pushed a little box toward the center of the table. "It contains a vial of vaccine, syringe, and a needle. Everything is sterile. The box should not be opened until just prior to use."

Use? What use? By whom? How?

Nobody made a motion to pick it up.

I caught the doctor's eye. He continued quietly, and he was talking directly to me. "I come to the point. Her Majesty proposes that someone go backward in time, to a date at least a month prior to the prince's death. The volunteer takes with him the typhoid vaccine, injects the prince, and returns. If all goes well, the prince does not contract typhoid, and indeed may live a long and useful life." He continued to look at me.

So *that* was what they wanted. That was why I was here. But no. Not *I*. I was not going to volunteer. Anyhow, for the time being I felt safe. They would first have to build a machine.

"What do you think, Mr. Wells?" the queen asked.

"I can speak only for the time machine, Your Majesty. If it is built, it ought to work. As for the rest, well, surely Your Majesty can see the problem. If the prince lives, tremendous changes in history could result. Our own lives could be altered in unpredictable ways. I might not be born. Dr. Wright, you might succumb to one of your own strange bacilli." I turned toward the equerry. "And in *that* world, Major, you might be killed in a war." I studied him, then asked bluntly, "Why don't *you* go, Major?"

He laughed in a couple of humorless gasps. "Quite right, Mr. Wells. Actually, as originally conceived, the Project was designed around me, right down to the fitting of my—ah—body—to the saddle of the machine."

I sat up suddenly. "Wait a moment . . . you mean . . . the machine has already been built?"

"Yes," said the major. "Perhaps we should have explained that earlier.

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Mr. Wilshire?"

"Built to your exact specifications, Mr. Wells," said the engineer. "Indeed at this very moment it is sitting in a room in Windsor Castle, ready to go."

My heart skipped a couple of beats. I was at a temporary loss for words. Finally I managed a feeble question. "So, Major, *you* are going?"

"No. There was a change of plans, Wells. The doctor has raised a serious objection to me. Doctor?"

"Yes. Actually, the problem that suggested the change of plans arose at Buckingham Palace, not at Windsor. It turns out that a lad, they call him 'Boy Cotton,' had been discovered under a sofa. He had been hiding in the royal suite for three days, rather like a human rat, eating leftover food, and generally keeping out of sight. Your Majesty may recall—?"

"I do indeed," murmured the queen. "A notorious incident. The Mudlark, the *Times* called him. He and I talked a bit before they took him away. Harmless, really, but it made everybody nervous." She sighed. "They doubled the guards. A month later though, another boy was found."

The doctor resumed. "The point is, Mr. Wells, and with all respect, a small man such as yourself would have a better chance than a big man, such as the major."

"Makes sense," I said curtly. "Less chance of getting shot."

The queen spoke. "Mr. Wells, we would not dream of persuading you against your will. Actually, when we decided against using Major Banning, we reverted to an earlier possibility, a quite diminutive person, and one very familiar with the Windsor routine of the time."

I caught a vision of that regal bottom in the saddle of the machine, and the Empress of India riding off into the unknown. It was unreal. I stammered, "Not *you,* Majesty!"

"Yes, Mr. Wells, I. This meeting is adjourned." She turned to her equerry. "Major Banning, you and I will proceed immediately to Windsor." She signalled her Hindu servant, and he took a step forward.

"No! Wait!" I jumped up. I had been thinking. And it was a crazy mix of thoughts. I couldn't analyze it all just then. Was I chivalrously risking my life for my queen? Never! As far as the monarchy was concerned there wasn't a chivalrous bone in my body. What was it, then? I was thinking, *my* machine. *My* invention. Mine, mine, *mine.* For better or worse, *I* was entitled to the first ride. Nobody else. Not even the queen!

"Majesty," I said calmly, "I will go. I insist. I know the machine better than anyone. My stature may indeed facilitate concealment, if that should become necessary. Of all present, I stand the best chance of saving the prince and coming back alive."

She sat there a moment, just looking at me. Then she smiled, and she bowed, not deeply, but graciously and sincerely, thereby demolishing the myth that the queen bowed to no one, not even to the Archbishop of Canterbury. "Let it be so. Major, will you and Mr. Wells kindly take the carriage to Windsor forthwith?"

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* * *

5. To Paddington

Major Banning picked up Dr. Wright's vaccine box from the table and put it in a small black satchel. Then he and I made our respectful farewells, and he led me down a flight of stairs to a side port, where a carriage waited. The door, I noted, carried the royal crest and the letters "VR." The driver whipped up the horses, and we set off at a great clip.

Windsor Town lay a little over twenty miles across the river and to the west, and it was well known that the fastest way to get there was to take the Great Western from Paddington Station, which lay a brisk half hour drive down High Holborn and Oxford Street. And here came a surprise. We didn't angle around the Marble Arch into Edgeware Road. We cut *through* Hyde Park. In fact, a gatekeeper opened the bars as soon as he saw the carriage approaching. It had all been prearranged, of course. Ordinary people would be arrested if they had tried the same shortcut* but *she* could get away with it without asking anybody. I sensed the power of that remarkable woman, and I was simultaneously annoyed and exhilarated.

In a way I was just as happy not to pass by the Arch. It marked the spot where in other days regicides and other high miscreants were publicly hanged. If I fouled up on the Project and the prince died at my hands, would I be hanged as a regicide? I shivered.

Major Banning looked over at me. "Cold?"

"Nervous," I said.

"Understandable." He peered out his window. "We're coming in to the station."

I looked at my watch. "When's the next train?"

"We have a special. Steam's up, and it's waiting."

Of course. And all other trains —mail, goods, express, local—would have to puff idly on lay-byes while her majesty's special made the wild dash to Windsor Town.

In a way, all this rush and bustle was quite silly. Whether we reached Windsor today, yesterday, or tomorrow, it wouldn't have the slightest effect on the pending scenario. The critical moment, for better or worse, had already occurred long ago.

The workmen at Paddington Station claim, with justifiable pride, that their station is the grimiest in London, hence in the world. Glass skylights over the tracks are cleaned periodically, but without much effect. A few days of chuffing locomotives suffice to undo the cleanups. The smoke even obliterates the words "Paddington" painted in large black letters on pilasters in the trackside walls. It is well to know where you are without reference to the printed word.

So it was another surprise to find the queen's special train in a newly scrubbed and white-washed shed, shut off from the curious by iron gates and armed guards. We were hardly aboard when the guards pulled the gates open and the train

*Ed. Note: This shortcut was opened to the public in 1908.

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began to jerk forward.

We found our seats, the major set his bag down, let out a long windy sigh, and pulled out a cigar. But then he frowned and put it away again.

I looked at him questioningly.

He shrugged. "I keep forgetting. She can't stand tobacco. She can even smell the traces on the fabrics and woodwork."

6. On the Train

"Are you familiar with Windsor Town?" asked the major.

"Just the common knowledge," I said. "The castle stands on a slight hill at the northeastern edge of the town. Legend has it that King Arthur conferred with his knights on that hill. Anyhow, when the Normans came, they built the tower on it as a fortress. The accessory buildings came later. A flag flies on the turret when the queen is in residence. No flag today, I suppose." I paused, then added noncommitally, "I was once apprenticed to a draper there. I could see the castle from the shop roof, and sometimes the royals playing beyond the walls."

He smiled faintly. "You didn't like the draper business?"

"No." I thought of Charles Dickens, and how he had been apprenticed to a maker of bootblacking, and how he had hated it. I knew just how he felt. My tone was so brusque as to seem tactless. I changed the subject. "Major," I said, "I once made a conservative estimate of what it would cost to build the machine. As I'm sure you know, it has some unusual components and requires painstaking manufacture and assembly. For parts and labour I estimated at least £ 100,000. The sapphire core alone would account for half of that. You can see why the machine would be beyond the means of myself or any other ordinary citizen."

"Yes, I can see that."

"So who is paying?"

"The queen."

"Even for the sapphire?"

"She is providing that."

I wasn't exactly sure what he meant. "You mean, she already had a stone of the exact specifications?"

"Yes."

I could see he wasn't inclined to elaborate. And actually, it didn't matter where the gem came from, so long as it would perform properly.

Major," I said, "you realize this is all quite mad."

He made no response.

I realized I had put him in an awkward position. Perhaps he didn't really believe in the Project, but he was totally loyal to the queen. Well, it was easy for him. He was just following orders. He was risking nothing, neither life nor sanity.

I was remorseless. "If I succeed in prolonging the life of the prince, *she* will never get the benefit of any additional years with him. It will be a different world, with a different Queen Victoria and a different Prince Albert. It cannot possibly come out the way she wants."

His mouth tightened. "Wells, I know that, you know that, Dr. Wright knows that. *She* does *not* know that. And which of us is willing to try to explain it to her?"

He had a point.

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"So," he said, "let's just go ahead as if everything made sense. And indeed, my dear fellow, it *could* make sense, though not exactly in the way *she* hopes for."

"What do you mean?"

"You've read about The *Trent* Affair?"

"Just what I was taught in school."

"And I suppose they taught you that the Affair started the Great Intervention, also known as the War of Sixty-One, where we came in on the side of the Confederates and clinched the Secession in the American Civil War?"

"And got the Southern Colonies back," I added.

"Just so," said the major. "And while we were busy grabbing the American South, the French picked up Quebec and Mexico. A disaster, Wells. We did it for the Lancashire mills, for cotton. In the beginning, that was fine. But today it's different. One third of the national income goes to the support of the Southern regime. We perpetuated slavery in the southern states. We are the shame of nations."

I couldn't see the connection between the Project and The *Trent* Affair, but I felt sure that the major was about to enlighten me.

He gave a short bitter laugh. "If the prince had lived, he could and would have prevented the War of the Intervention. In fact, if he had lived just a couple of weeks longer, he might have managed it." He tugged at his mustache. "So you see, Wells, it's either a mad fiasco, or else it's a thing of great wonder, and the salvation of Britain. But you must understand *Trent*. There's much more to the Affair than you'll find in the history books." He had to stop temporarily. The train had rolled into Windsor Station. We stepped down from the cars, into a waiting carriage, and were immediately on our way to the castle.

Inside the carriage the major resumed his exposition of The *Trent* Affair.

7. *The* Trent *Affair*

"By the fall of 1861," continued the major, "the federal blockade of southern ports was seriously hurting the Confederacy. Jefferson Davis, the Confederate president, attempted to send commissioners to England and France to seek naval aid in breaking the blockade. The agent to London was Mr. James M. Mason, and the man headed for Paris was Mr. John Slidell. The Americans boarded a British Royal Mail packet in Havana, the *Trent*, under Captain Moir. At noon, November 8, 1861, one day out of Havana, the *Trent* was stopped in Bahama Channel by the *San Jacinto*, a screw sloop of the federal navy. American marines forcibly removed Mason and Slidell." He stopped for a moment and we both held to the side straps as the carriage bounced over a cluster of potholes.

"Dates," said the major as he caught his breath, "now become important. After a fair voyage of nineteen days, the *Trent* reached London. You hadn't been born yet, Wells, and I was just a lad of ten, but I remember it vividly. I remember the mobs in the streets, the spontaneous parades, the

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scenes in front of the American Embassy. The *Times* rushed extra editions to the streets every few hours, and finally brought out an edition with just one word on the front page, in big black letters: WAR. Eight thousand troops were called up and loaded onto ships for Canada. Lord Russell, Secretary for Foreign Affairs, urged that war be declared immediately. He prepared an appropriate message for the prime minister to present to parliament and to the queen. On this same day Prince Albert was moved from his apartment in the castle to the Blue Room. He was dying, and the Blue Room was the proper room to die in. George Fourth and William Fourth had died there. And so the prince died, December 1, 1861.

"As you probably know, the queen customarily consulted the prince on all matters of state, but now, in his present condition this was no longer possible. So when Prime Minister Palmerston brought her Russell's proposed note, she had only the judgment of her ministers to guide her, and the consequences were catastrophic. Russell's note was an ultimatum. It demanded the release of the two commissioners and an immediate apology. The wording was so insulting that no nation could, in honour, answer it. It was delivered December 18 in Washington to Lord Lyons, the British ambassador there, and he immediately passed it on to Secretary of State Seward. Lincoln and his cabinet considered it a few days later. It was of course never answered. Parliament duly declared war, and the Great Intervention was on. In sixty-two the British navy broke the federal blockade, and Lee beat McClellan at Antietam, and the next year he took Washington.

"But while we were busy getting entangled in the American war, the French had not been idle. They supported the uprising in Quebec and made a colony of Mexico." He sighed. "All for cotton, Wells. Our entire Industrial Revolution was based on cotton, grown and picked by slaves in Mississippi, and Louisiana, and Alabama, and Georgia. In 1860 we imported over one billion pounds of American cotton into Liverpool. Directly or indirectly, our Lancashire mills supported hundreds of thousands of millhands, shipbuilders, sailors, and clerks—workers in a dazzling occupational array, and their families. If we lost our supply of cheap cotton, we all knew the mills would close and the government would fall. Today we look at it differently, of course. Today Indian cotton is both better and cheaper than Confederate cotton, and our entire textile trade accounts for less than 10 percent of our gross national product. Looking back, we can see that the Intervention was a ghastly error."

He seemed to have all the facts at his fingertips. But what was he adding that couldn't be found in the history books? I said, "And you believe that if the prince had lived, he could have prevented the Intervention?"

"Yes."

"So *that's* the real reason for all this?"

"From my viewpoint, again, yes."

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I thought about that. We weren't going to restore Albert to the Widow, but perhaps we could restore honour to old England. No more textiles from slave-grown cotton.

But I had another question. "Did they know Albert had typhoid?"

"They knew."

"Surely there was *some* sort of treatment available?"

He smiled grimly. "That brings us to the question of Dr. James Clark, the palace physician."

"Clark. . . ? He wasn't mentioned back at the conference?"

"No. And with good reason. The queen insisted that he and he alone attend the prince. The modern medical profession, including Dr. Wright, has tactfully refrained from questioning her judgment, at least within her presence."

"He was a quack?"

"No, Wells, he was not a quack. He was actually quite skilled. Indeed, he was thoroughly familiar with the accepted treatment of typhoid."

"Which was?"

"With no treatment, the fever rises quickly, to 104°, and stays there. In eight days, more or less, the patient dies. Treatment is simple: keep the fever down with cold baths. Dr. Clark didn't do that. Save for a daily visit to the patient and periodic assurances to the queen, he did nothing."

"But he *knew?* You said he *knew?*"

"He knew. He knew several things, Wells. Probably the thing uppermost in his mind during the critical period of November-December 1861 was the fact that in '59 and '60 he had invested heavily in half a dozen mills in Lancashire. He had done this with borrowed money. If cotton was cut off he would be ruined. He might even have to call on the queen to save him from debtor's prison. He knew the prince hated slavery. He knew that if the prince got into the act, Britain would remain neutral."

"But . . . no . . . surely . . . ?" I understood what the major was telling me. I just couldn't bring myself to put it in words.

He laughed his bitter humorless bark. "You're looking for a nice word, Wells? Something like 'negligent homicide'? Or 'reckless manslaughter'? You don't like 'murder premeditated'?"

I had no ready answer.

He said, "Calm yourself. Shortly after Albert's death she knighted James Clark, and he died within the year. Her carriage was first in line at his funeral, and she wept."

"As well she should have," I muttered.

"*De mortuis,* Wells," he chided. "I mention this to fill you in on the situation, and to explain why you can expect no cooperation from Dr. Clark. Avoid him if you can. Ah, here we are. We'll go on up."

8. The Time Machine

The two guards at the castle gate stood at attention as our carriage rattled past. A moment later we were at a side entrance of the main residence building and on our way up into the castle.

I stole a glance at my watch: it was just a few minutes before noon. Where had the time gone? I thought

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of Jane. She would soon be having a bit of lunch. I wished I could be with her!

We walked into a gloomy high-ceilinged hallway, then toward a double door guarded by a sergeant in blue palace livery. The non-com snapped to attention and saluted as we approached. The major returned the salute. "At ease, sergeant. Mr. Wells, meet Sergeant Roper."

"Sir!" snapped the sergeant.

"Sergeant Roper has the responsibility of guarding these rooms," said the major.

Meaning (I translated), we can work without interruption.

We went on inside.

"This is the prince's bedroom, two single beds, some chairs, a table," said Banning. "That door over there leads to his study. Everything here is pretty much the same as when he died."

"But he didn't die here, not in this room?"

"That's true. He was ill here, in that bed, for three weeks. At the very last, though, he was moved to the Blue Room, and he died there."

"December 1, 1861."

"That's correct. Come, let's go into his study."

Within the study, off to one side where it could not easily be seen from the bedroom, stood something about the size of a large chair, and covered by a white canvas tarpaulin. I knew what it was. I walked over and gingerly pulled the coverlet off.

With blended awe, reverence, and curiosity, I inspected the Time Machine.

The major watched me in silence for a moment, then he said, "With a couple of minor modifications we have followed fairly faithfully the description in your patent."

Modifications? I wondered. No changes were immediately apparent. So far as I could see they had done a fine job. The saddle was placed properly over the battery compartment, slightly off-center, as required, and fronting the console, with two time dials; the whole being constructed within a framework of glittering brass rails.

The core of the system, the thing that actually altered the four dimensions enclosing the machine, was presumably positioned in place under the dial console. The access panels had already been folded out for my inspection. I knelt down and began checking the internals. Primarily I was looking for the crystal that had to be there for the machine to work—a great blue sapphire.

I stared. The gem-receptacle was there, all right. But it was empty.

My feelings at that instant were impossible to describe. I felt acute disappointment. I felt anger. I felt relief. At least I would not be arrested and/or shot in 1861 for being in the wrong place at the wrong time. My feelings coalesced into a question mark. I twisted my neck and looked up at Banning.

He was in the act of taking something from his black satchel. "Is this what you're looking for?" He held up a sizeable piece of jewelry, a brooch: an outsize sapphire. He was grinning.

I took it from him without a word. It was difficult to be angry at this man.

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A close inspection satisfied me that the jewel would not have to be removed from the setting in order to mount it in the machine. I leaned back into the core compartment and clipped the brooch into its mountings. Then I closed the panel doors carefully and got to my feet.

Banning watched me in silence.

I studied the two time dials in the console. "These are your 'minor modifications'?"

"Yes. In your patent you call for four time dials: days, thousand days, million, and billion. As you see, this machine has only two dials, one for days, the other for thousands of days. For the Project you should need only these two."

"I see two marks on the thousand-day dial," I said. "I assume the first is set for early November, 1861?"

"Yes, as a matter of fact, November first."

"And the other mark brings me back here, to 1894?"

"Right again."

I held up a hand. I had to think about this. The time of return was critical. I pulled my watch from my waistcoat. It was high noon. Suppose I return today, but at 11 A.M.? I haven't left yet. In fact, at that hour the train is pulling out of Paddington Station. Then, how about returning at 12 noon? That doesn't work either. Wells, returning from 1861, meets me, Wells leaving for 1861. Do we exchange nods in silence? Do we speak? Does the returning Wells say to me, you had better go on, else I can't return as me? And how might I reply? I might well say, indeed, old chap, since you're here, it's clear I've already been there. So there's no need now for me to go. In fact, if I went, you and I might be caught in an iterative time oscillation that would never end.

I scowled and shook my head in an attempt to bring order out of the time-paradoxes. This seemed to amuse Banning. I realized then that he had already considered the problem.

"The time forward dial is set for one A.M. tomorrow morning," he said. "You'll return twelve hours after you leave. That gives you plenty of clearance. You won't meet yourself *en route* at any point. It'll be nighttime, but that should not be a problem. I'll be here, waiting for you."

I breathed a long sigh. "All right." I examined the time forward dial again. "What happens if I accidentally overshoot the one A.M. exit?"

"Just use the reverse time lever and come back to the proper moment."

"But what's this red mark, one at the far edge of the dial?"

Banning winced. "Sort of a contingency exit, in case things get totally fouled up. Can't think of any reason why you might need it. Anyhow, it brings you out about one hundred years from today—into the closing years of the twentieth century."

Something to keep in mind. I pointed to the threaded studs on the console. "You have the control levers?"

Banning pulled them from his leather case. "We know they thread on properly. However, they have not been used to actually operate the ma-

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chine." He handed them over, and I got into the saddle and screwed the handles onto the studs. The one on the right should take the traveler forward in time, the other into the past.

"The vaccine?" I said.

The major pulled the third and final item from his black bag: the little vaccine box. He handed it over to me, and I pushed it carefully into an inner jacket pocket. He checked his watch. "Five minutes after twelve. Remember, be back here at one A.M. tomorrow. Good luck, Wells." We shook hands. There was no expression at all on his face.

It was time to go.

How had I let this happen to me?

I ground my teeth, grabbed the back-time lever.... I think the major said something... as he saluted ... and vanished.

I was falling, and whirling around and around in some sort of time-swept vortex. I screamed, but of course no one heard, and even if they had, they could have done nothing for me. I was certain that I was going to crash into something, that every bone in my body would be broken, that I would conclude my twenty-eight years as an unrecognizable bloody pulp. For the first time I had intimations that Isabel, my first wife, was right: I should not have tried to rise above my station. I should never have gone into science, and writing. I should have remained a draper's assistant. But then I thought, no. Never. Death first.

I found myself gasping and sweating and still sitting in the saddle of the Machine, and still in the prince's study in Windsor castle.

The room was well lighted. At least I had arrived in daylight. Shakily, I got out of the Machine and looked about the little room. It differed but little from the room I had just left. It seemed to have the same furniture, the same bookshelves, even the same books. *She* had left everything the way it was when he had died. The only functional difference seemed to be the lamp over the study desk. Here, in 1861, it was the new brilliant Welsbach gas-mantle. In 1894 it had been the new electric light bulb (which, in my humble opinion, gave somewhat less light). Progress.

The only sound in the room was the ticking of the clock on the far side of the desk. I glanced at the dial. Ten fifteen. A.M., of course. Beside the clock lay a newspaper. I tiptoed over and looked at the date: November 1, 1861. So far so good.

It was time to get down to business. I unscrewed the two drive levers and put them in my jacket pocket next to the syringe case. I took a deep breath, gathered my courage, and peeked around the half-open study door and into the prince's bedroom.

He was lying on his bed against a bulwark of pillows. His head was canted to one side and his eyes were closed.

I studied him for a moment. Could *this* be Prince Albert? His portraits showed him as tall, erect, chin lifted proudly, hand on sword pommel. What I saw here was as shrunken wreck, a near cadaver, a creature with hollow ivory-coloured cheeks. The nose, formerly merely aquiline, was

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now blade-like from emaciation. The wispy hair was in disarray. His once bountiful beard that looped under his chin was gone, presumably shaved off to facilitate bedside care. The room gave off a sickly sweet perfume: the odor of terminal illness, the smell of death.

My first thought was, the vaccine is too late.

I took a step forward. Even under the thick carpet the floor boards creaked.

The sick man opened his eyes and looked at me.

9. Albert

He rose shakily on an elbow and blinked in my general direction. "Who are you?" he croaked.

I approached and bowed with dignity. "Sire, my name is Wells. I'm your new medical orderly."

"I don't remember. . . ." He peered over to the hall door. "When did you come in?"

"Just now, Highness. But I didn't come in through the hall door. I entered via your study."

He passed his hand over his brow. "Wells. . . . The study . . . ?" He gave me a suspicious look and fumbled for the bellpull just over his head.

I rushed forward. "Please, sire. Let me explain."

"Oh?" He lay back in bed, but his eyes never left me.

I went on hurriedly. "Highness, what I am about to say, I know you will find quite incredible. Yet, if you will permit, I know I can prove it all to your satisfaction. To start, sire, I am from the year 1894. I came here in a Time Machine, which at the moment stands in your study."

I let him think about that. Clearly, he didn't believe me. Nor did I expect him to. Not yet, anyway.

"Go on," he said. "Why did you come? To what end?"

"Sire, it now becomes difficult. For what I am about to reveal to you, I ask your forbearance in advance."

"I forbear. So tell me."

"Sire, you are presently in a very rundown condition, compounded by a case of influenza brought on by exposure to rain and cold during your recent visit to Cambridge."*

He looked at me sharply. "So?"

"That's not the worst of it, sire. In a day or so, indeed, perhaps even as we talk here, you will contract typhoid . . . and . . ." I gulped and coughed.

"And I will die?"

I nodded silently. He was taking it very well, perhaps in large part because he didn't necessarily believe me.

"When?"

There was no gentle way to put it. "You will die the first of December, sire."

He considered that. I think he almost smiled. "And in your world of 1894, is December first carved on my gravestone?"

"Yes, sire."

It didn't seem to bother him. When death is close, everything in life seems to shift focus. Many things

*Ed. Note: Prince Albert apparently caught influenza during a recent visit to his son, Edward, at Cambridge University.

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once critically important become trivial, and vice versa. I think this was already happening to Albert.

"To survive a dozen assassination attempts," he murmured, "only to be brought low by an invisible bug."

The statement about the bug astonished me. But then, I should have recalled that he read all the new science journals. Pasteur had published his seminal papers on microorganisms only three years ago, by the prince's calendar.

"Wells," he said, "dying is not such a terrible thing."

"Sire," I admonished him, "after your death, her majesty went—or should I say, will go?—into a secluded mourning that was still going on when I left my world of 1894. She still wears black. For her, your death was—will be—a terrible thing." I paused and took a deep breath. "It is time to state my mission."

"Yes, Wells, please do."

"I am here by the queen's order and request. She thinks I can save your life."

"She was always overly sentimental," he muttered. "Do you know she still has all her dolls from childhood, catalogued and stored away?"

"No, sire, I didn't. But surely you don't want to die?"

"You're blunt, Wells. And that's good. Saves time. So let's get to the facts. You claim the queen sent you?"

"Yes, sire."

"That should be easy to verify. I'll ring for her."

"That won't work, sire. Her majesty of 1894 sent me. The present queen never heard of me. *She* would send for the palace guard."

"Oh. Hm." He peered at me quizzically. "We'll try something else. You claim you came here in some sort of vehicle?"

"Yes, sire. A Time Machine."

"So you say. And it's presently sitting in my study?"

"It is, sire."

"Help me up, Wells."

"Of course, sire." I'm not a big man. The prince was not much taller, at five foot seven. He got an arm over my shoulder and we walked slowly, step by step, into the study. I could sense from the contact that he was running a high fever.

When he saw the Machine, his eyes opened wide, and he stumbled. I held him tight. I had a pretty good idea what he was thinking: that thing is too big to come in through the study door. How did it get in here? Is this for real?

He asked in a rasping whisper, "Perhaps the queen gave you a note for me?"

"No, sire."

"Nothing to prove this was her idea?"

I sighed. "Not exactly. But at least I've got the typhoid vaccine . . . for whatever that proves."

"Vaccine?"

"Dr. Wright—Sir Almroth Wright—prepared it. If the injection is given in time, it will provide immunity to the disease. Rather like a smallpox vaccine, I'm told."

He was frowning. "Not even a glove, a ring, a fan . . . ? Most unlike her."

So *that* was what was bothering

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him. "Sire, a moment please." I bent down into the internals of the Machine, loosened the contacts that held the sapphire brooch, and extracted it with infinite care. I held it up. "Sire, do you recognize this?"

He stared in amazement, then took it with his free hand. "The Juggernaut!" he whispered.

"The . . . *what?*"

"Juggernaut, Wells. It wrecked the financial system of my little duchy of Saxe-Coburg-Gotha for a decade. This is the brooch I gave Victoria to wear at our wedding. How did you come by it?"

"We needed it for the piezoelectric unit in the Machine. She gave it. I have to return it when this is over."

"Yes, of course. All right, Wells, I believe you. I believe everything." He handed the stone back, and I reclamped it into the core box. He did not raise the question of whether there were now *two* Juggernauts, this one, and a second in the Windsor strongbox. I would not have known how to answer!

"Wells," he said, "am I to understand that you risked your life to save mine?"

That was certainly one way to look at it. I shrugged. "Sire, the risk is difficult to assess. Permit me to say, simply, that I was glad to come, and I hope that with my coming your life will be prolonged."

"Well said. Thank you. Now what?" he asked.

"Three things, sire. First, let's get you back to bed. Second, I recommend that I administer the vaccine, followed by a cold sponge bath. We need to get your fever down."

"Yes. I'm very tired, Wells. Let's get on with it."

I got him back to bed. A few minutes later I had drawn the required three cc of vaccine from the vial into the hypo, pushed the plunger up to get rid of the air bubble, and thrust the needle into the royal rump. It bothered me that the prince didn't wince.

I brought a basin of water over to the night stand, found a clean towel by the commode rack, pulled his nightgown up around his armpits, and began to sponge him down, front and back. By the time I had finished not even his mother had ever seen more of Albert than I. Was I really doing him any good? Just then, of course, it was impossible to tell. But I had an uneasy feeling that he had already contracted the disease and that I was too late with the vaccine. I would have to wait for history to give its final judgment. As I pulled down his nightdress he murmured, "You said three things, Wells. What's number three?"

"A ship, sire, the *Trent*—"

There was a knock on the door. I jerked around guiltily. A little man stood there, age about fifty, with short white hair, razor-sharp nose, gimlet black eyes. I knew him from the major's description.

"Come in, Dr. Clark," I said coolly.

10. The Last Memo

The resident physician stared at me, then at the prince, who seemed to be half-dozing, then back at me. "Who are you? What are you doing

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here?"

"The name is Wells, doctor, H. G. Wells, of London." I was trying to think up a plausible story that might explain why I was here, when the prince woke up, saw the newcomer, and quickly grasped my predicament.

"James," said the prince quietly, "Would you mind waiting outside for a moment? I'll ring for you."

"But milord, you're to have no visitors.... Who...? Why...?"

"If you please, James."

One of the prerequisites of royalty is, they don't have to explain anything.

The doctor gave me one last hard look then bowed and left the room.

"Wells," said the prince, "it's hard for me to stay awake. We'll have to make it short. The *Trent*...?"

"Yes, sire. Know then, that twenty-seven days hence, on November 27, the Royal Mail Packet *Trent,* under Captain Moir, will dock at London. Captain Moir will make his report direct to Lord Russell, and he will say that a warship of the Federal American navy stopped the *Trent* and forcibly removed two civilian passengers, a Mr. Mason and a Mr. Slidell. Russell declares for war. The prime minister wavers, but finally agrees. They draft an ultimatum to be delivered to the American ambassador in London. They run it by the queen. She wants very much to have your advice, but you are in a near coma." I paused. "Do you follow me, sire?"

"I'm ahead of you, Wells. It's cotton, isn't it?"

"Yes, sire."

"And so we come in on the side of the Confederacy?"

"Yes, sire. The navy broke the blockade and assured their independence."

He was silent for a while. "And slavery? In your 1894 does slavery yet persist in the American South?"

I hesitated. "Yes, sire." This must be especially bad news for the one-time president of the Anti-slavery Society.

"And I did—do—nothing?"

I, too, was having trouble with the tenses. My future was equally my past. "You were totally out of it, sire. You died December first, the day Russell declared war. We call it the War of Intervention—as every schoolboy knows."

"Sad, sad," he muttered. He lay there silently for a time, then looked up at me. "You'll have to leave in a few minutes, Wells, else Dr. Clark will make a scene. But you can come back, can't you?"

"Yes, sire. I'll be looking in on you from time to time." I walked in to the study and closed the door quietly. I was determined to give him more cold baths in the coming days, episodes that would take only a few minutes of Machine time, but would spread out over several weeks on the prince's calendar. Even if the typhoid vaccine didn't work, bringing his fever down ought to give him a few extra days of life.

The next several calendar days were oddities. For me they went by in spurts of a few minutes each. While dodging visits of the queen and Dr. Clark, I did indeed manage to give the prince intermittent sponge baths.

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Whether this amateurish treatment helped him, or whether it was Dr. Wright's vaccine, or both (or neither!) probably no one will ever know for sure. At least I don't believe they hurt. Something was definitely prolonging his life.

On the morning of November 27 the prince was definitely worse than our first encounter. On the other hand he was far from lying in a coma. Already, history as I knew it was changing. And both of us were waiting for news of the *Trent*.

During the afternoon of November 28 the explosive news reached Windsor Train Station by telegraph, and so on to the castle by fast rider. The queen herself brought the despatch to the prince's bedside.

I put my ear to a crack at the study door.

The queen was distraught. "Oh Bertie, those awful people. What shall we do?"

"What does Russell say?" he asked in a hoarse whisper.

I could hardly hear him.

The queen said, "He's preparing an ultimatum to give the American ambassador."

That would be Charles Francis Adams, in London, I thought.

"Palmerston?" whispered the prince.

"I think the PM would prefer to delay," she said.

"Vicki . . . we cannot permit this madness. Insist . . . that Palmerston bring Russell's note to you."

"Yes, dear, of course."

He murmured something else. I couldn't quite make it out, but it might have been, "Schnell . . . schnell. . . ." *Quickly, quickly.* He was determined to outlive and remold his own predestined history.

And now the literal anomalies begin.

One history says he died December 1, 1861, another on December 14, 1861. Both are right, of course, depending on in which world one lives. I, who write this, am a citizen of both worlds. Except that I renounced my citizenship in that gloomy world where Albert, Prince Consort, died December 1.

For in the history I now relate, he did not die on December 1. As we can look at any of his stone-carved memorials, we see from the dates there engraved that his great spirit left my newly adopted world on December 14. And in that additional two weeks he changed history drastically and dramatically and forever.

What gave him that extra two weeks? Did Dr. Wright's typhoid vaccine help? Maybe a little. Did the cold baths help? Perhaps. In my own humble opinion I believe his own iron will gave him the added time. He was determined to stop the war before it started.

At six-thirty on the cold dark morning of November 30, 1861, Victoria in her dressing gown and carrying a lantern, brought Lord Russell's proposed notes to Albert's bedside. The ministers had evidently worked on them all night in the conference room downstairs. I watched from a crack in the study door.

"Let me think about it, Schaetze," he said.

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So she left him. I hurried out and helped him struggle to his study desk. He sat there, read the papers by gaslight, and groaned. "This means war! Oh what fools!" He began fumbling for pen and paper. I put them in front of him.

He picked up the pen, dipped it into the inkwell with trembling fingers, then waited until his hand steadied. "Lincoln," he murmured. "Abraham Lincoln surely never authorized stopping the *Trent.*"

"Can you give him a way out, sire?"

"I think so. He's smart, and he'll meet us halfway." He dipped the pen in the inkwell again. This time his hand did not tremble. He whispered the words as he wrote, slowly, carefully, "The Queen returns these important Drafts," (German-style, he capitalized all nouns) "which on the Whole she approves . . . but she cannot help feeling that the second Draft . . . is somewhat meagre. We would like to have seen the Expression of a Hope that the American Captain did not act under Instructions, or if he did, that he misapprehended them. . . . The U.S. Government must be fully aware that the British Government could not permit its flag to be insulted." He sat back in his chair, exhausted. I heard him mutter, "Ich bin so swach ich habe kaum die Feder halten koennen." *I am so weak I can scarcely hold the pen.* It was true. He dropped it to floor. I picked it up and returned it to his desk.

It was 7 A.M.

"Wells," he muttered, "this is the end. I am soon gone. In a year I will be totally forgotten."

"Sire," I said, "You completely misapprehend your position in history.

"The English people finally awakened to your benefits to the country. You will be known as Albert the Good. Monuments will be erected to you all over London. Indeed, all over the country. Historians will proclaim you England's greatest king since Alfred. And all this without knowing that you probably prevented a war today."

He just looked at me, puzzled. "I fear you're greatly misinformed, Wells. I think it likely that at most I'll be remembered as a horseman. I once jumped a five-bar fence . . . that's all these people care about. They've already forgotten the Great Exhibition of 1851, and the things I did for science and education."

"Sire," I said, "aside from how the English regard you, I strongly believe that your rescript will let Mr. Lincoln win his war and free five million slaves."

"Do you really think so, Wells?"

"Of course, sire. Shall I help you back to bed?"

"Please. Then you'll have to leave. The messenger is due back any minute."

As we all now know, the prince's rescript to Lord Russell was his last memo and last official act. A week later he was moved into the Blue Room, where he died on December 14.

I said goodbye, got in the Time Machine, and pressed the lever forward, to 1894 and Major Banning. And Jane. Especially Jane.

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* * *

11. 1894

When the room stopped trembling and came into final focus I found myself staring straight into the barrel of a Webley 38. In the dim half-light, just above the revolver a grim face looked down at me. It was Major Banning. Not surprising. He was supposed to be here when I "came back," and indeed, here he was. But he looked . . . somehow different. And for God's sake, why the pistol!? Something was wrong, terribly wrong. I continued to look up, with my eyes going back and forth between his face and that horrid weapon. "Major Banning?" I said weakly.

His weapon barrel did not waver a micron; yet when I called his name his eyes widened. He said, "I'm *Captain* Banning. Who are *you?* How did you come here?" Translation: Give me a good reason why I shouldn't scatter your brains all over the carpet.

I hit the depths then. In this new world he was not the queen's trusted equerry sharing a crucial mission with me. He was not a major. He was a captain in the Windsor guards, and he was my enemy.

What else was strange and different? Jane? Did I still have Jane? Would *she* know me?

"My name is Wells," I said mournfully. "H. G. Wells." Just then I thought of one last possibility of salvation. "Major . . . Captain, I mean . . . would you please call Sergeant Roper. He knows me. He can vouch for me."

He frowned. "There's no one around here named Roper, sergeant or otherwise."

No Sergeant Roper, either. Of course.

"And now, Mr. Wells, I'll thank you to raise you hands and step out of that infernal machine. Real easy, now." He made an imperious motion with his pistol.

"All right," I said. Very quickly, I looked about the study. It was night, that much was per schedule. The only light in here still came from a small electric bulb sconced on the study wall. I could see no changes. In the half light I surreptitiously unscrewed the back-time lever from its stud and stuck it up my sleeve. A desperate idea was forming.

"Up, up!" Captain Banning commanded. "And tell me, what *is* this thing?"

I stood up slowly from the saddle, raised my hands, and stepped down out of the vehicle. "Captain, I'll explain everything. But first, please tell me what day it is."

He looked puzzled. "Thursday, of course."

"The full date?" I persisted.

"June 7, 1894, about one-thirty in the morning." He glowered at me. "All right young man, your turn. What is going on here?"

I sighed. Right place, right time —but everything was wrong. I said, "This is a machine for traveling in time, Captain. I've just come from the year 1861. I was attempting to prolong the life of Prince Albert." First the captain frowned, then he grimaced, and finally he grinned. (This was not going well.) I said, "I know how this must sound, Captain, but I

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can assure you, it's true. I'm not crazy. But tell me, is Prince Albert alive or dead?"

That got him to frowning again. "You really don't know?"

"I *don't* know. Please tell me."

"Dead these many years, laddie."

That could mean anything. "Did he die in 1861?"

"Something like that."

It was ironic that I, who had been there, had to ask these questions. The whole world knew the answers, but not I. So the prince had died pretty much according to history. Too bad for the queen, I thought. But in this world she probably doesn't even know she tried to save him. So what else happened, or not happened? What was the great defining fact for this new 1894? "Captain Banning," I said, "I know this sounds like another very strange question, but I have to ask. Who won the American Civil War?"

"Why, laddie, you're not only crazy, you're ignorant. The North won it—the Feds."

"We didn't intervene on the side of the Confederacy?"

"Where were you schooled, young fellow? No, we didn't intervene. We stayed neutral."

"And France didn't grab Quebec and Mexico?"

He peered at me curiously. "Sonny, enough of this. You're over my head. Maybe Scotland Yard can make some sense out of you."

That would not do. I realized now that I had surfaced in a world that had been greatly altered by my visit to 1861. I also realized that I was now in a place I should not be and that I faced prison. And Jane—?

I had to get out of here.

"Captain, I hope you'll permit a personal question?"

"Go ahead, not that I have to answer it."

"Of course. Are you married?"

"No, no time for that foolishness."

"That's fine. Parents depend on you?"

"They're both dead and buried." He crossed himself.

"You're all alone."

"In a manner of speaking."

"Captain," I said, "I'll be happy to go with you. I'm sure I can explain everything to the police. But first, let me turn off the machine. We can't let it overheat. I'll have to get back in it to shut it off."

The machine was, in fact, still humming, as indeed it should. Even though the battery current was turned off, the piezoelectic core would continue vibrating for a few moments as a result of the residual interplay between the alumina atoms in the sapphire crystal. But it couldn't last long. Already the oscillations were audibly damping. I had to move fast. I held a finger to my lips. "Listen!"

He could hear it, and I could see it worried him. He looked at me, then at the machine. Obviously his mind was working carefully. I knew what he was thinking. He wasn't sure he believed the machine would overheat, but on the other hand he certainly didn't want to be held responsible for a disaster in the study of the late prince. "How do you turn it off?"

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he asked.

"Simple. See that little white lever? I sit in the saddle and pull the lever slowly to the right." I took a step toward the machine.

"Not so fast, me bucko. You stand in front there, where I can keep an eye on you. *I'll* turn it off."

"But—"

"Move!"

"All right, all right." Meekly, I moved over to the front of the machine.

The captain pointed his pistol with his left hand and grasped the time-forward lever in his right.

"Move it slowly, all the way to the right," I said.

He did. The machine shimmered, vibrated, and vanished. The last I saw of Captain Banning was a mouth wide with horror. And the last sound was a kind of "pop." He had pulled the trigger on his revolver, but of course by the time the bullet reached the spot where I had been, it would be the 1990s, and my brains would not be spread about on the carpet as intended.

I hefted the back-time lever in my left hand. Without it, the captain could never return here.

I walked over to the study window and looked down. It was still dark, but by dim moonlight I made out a big clump of bushes—probably the queen's prize azaleas—beneath the window. I dropped the lever into the bushes.

Was it a cruel thing that I had done to the captain? Well, yes and no. The captain will emerge in Albert's study in the closing years of the twentieth century, in possession of a sapphire brooch worth millions. Overnight he will be rich and famous.

There might be one little problem. Banning had fired one shot before leaving our mutual 1894. I don't pretend to be a ballistics expert, but it appeared to me that when the bullet finally emerged it might strike the socket of the electric light. If it did that, a serious electrical fire could result. Windsor had a stone veneer, true, but inside it was 90 percent wood. Very dry wood. The bullet would emerge simultaneously with Captain Banning, and there would be a memorable blaze.* I hope the captain finds the brooch and gets away safe and sound.

I finally got around to looking at my watch. It was 1:40 A.M. The time was exactly right, so why did I feel strange? I took a hurried look at my face in the little hand mirror in the prince's desk. The upper lip of the new Wells sported a rakish mustache. I could not remember acquiring it. I touched it tentatively. Not bad, not bad. But how would I explain it to Jane? When I left her yesterday morning I had been clean-shaven. Oh well . . . sort it all out later.

Within the next ten minutes I climbed out the window, dropped into the azaleas, and strode brazenly to the servant's way-in, where I signed the check-out book and bid a cheery farewell to the sleepy guard. I

*Ed. Note: The cause of the famous Windsor Castle Fire of November 1992 has never been conclusively determined. Nor is it certain that Captain Banning emerged on that occasion.

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started walking to the town and the G.W. station, mumbling all the while, "Jane, Jane. . . ." Finally, the morning trains began arriving. I caught one and was back in Paddington Station within the hour. Next, I awakened a sleeping cabbie in the stalls. "Twelve Mornington Place," I said. And off we went.

In leaving 1861 I regretted but one thing. I had wanted to see the face of Dr. James Clark when he realized there would be no war, and no cotton for his Lancashire mills. Of course, in this new world, perhaps history records him as a simple quack, and not at all an evil creature who tried to hurry the death of the prince. I hope so.

How much of this should I tell Jane? The answer was simple: nothing, not a word. It would be too much for her. In the first place, she wouldn't believe it. She was a well-adjusted citizen of a different world, a world where America was whole and intact, and had been ever since the close of the American Civil War; a world where Quebec had never broken away from Canada, and France did not claim Mexico.

It was now broad daylight, and I was home. I paid off the driver with my remaining coins and ran up the stairs to the door. I paused for a moment and read the names on the mail slot: Mr. & Mrs. H. G. Wells. We still existed! I fought back tears. We were as yet not truly married, of course. But we would be, as soon as my divorce from Isabel became final.

I opened the door and picked up the mail lying there. There were two letters. They could wait. I wanted to shriek "Jane! Jane! Be there, Jane!" But of course I didn't. That would wake everybody up, including the landlady.

So I burst unannounced into our little bedroom. She was lying there, huddled against the cold, on my side of the bed, hugging my pillow. I looked down at her, speechless. All I could think was, oh Jane, how beautiful you are, and how I do love you!

She must have sensed something. She opened one eye and looked up at me. "Back so soon? How was your walk?"

"Walk?" In this world I must have told her I was taking an early morning walk.

She sat up, clutching the blankets about her chest. "I wasn't expecting you quite so soon, or I'd have put the tea on." She looked at my right hand. "Mail? So early?"

"From yesterday, I think. We must have missed it." I looked at the letters for the first time. One was from the Patent Office. I broke into a sweat as I opened the envelope.

"Your invention?" she asked mildly.

"I guess so."

"Well, read it."

I did. "Dear Sir . . . blah blah blah . . . Please find below a communication from the Examiner blah blah. . . . First ground of rejection, neither the machine described nor the method of using it appears to fit any of the classes of patentable inventions. Second ground of rejection: the contrivance appears to lack utility. To

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meet this rejection it will be necessary to present and successfully demonstrate a working model. Third ground of rejection: the invention is anticipated by prior publications, viz., Wells, H.G., *Science Schools Journal* (1888). In sum, the Applicant should not expect a grant of a patent on the alleged invention. Respectfully, for the Comptroller, blah blah, and so on."

"They turned down your patent?"

"Yes."

That didn't satisfy her. "So why do you look so happy?"

"I didn't really want to bother with it." I pictured the Patent Office. At least now it had that big beautiful building all to itself. In this world, no Confederate Resident Office, no spittoons. The United States of America was whole and sound, and cotton was still pouring into Liverpool. I had a lot of history and geography to catch up on, and I'd probably make a few silly mistakes in the process. Right now, though, I was broke, and I had rent to pay and mouths to feed.

"What's the other letter?" Jane asked.

I'd almost forgotten it. I opened it carefully and took out a folded paper. A smaller piece of paper escaped and fluttered to the floor. Jane pounced on it like a hawk.

"A cheque!" she cried. *"A hundred pounds!* From the *New Review!"* She kissed it. I didn't blame her. "Henley?"* she asked.

*Ed. Note: William Ernest Henley, 1849–1903, famous London editor and poet, known to American readers best for his great self-paean, *Invictus.*

"Yes. Listen to this. He wants me to rewrite the time travel articles as a novel. He'll serialize it as *The Time Traveler,* starting in January next year. And that's not all. He's arranged for a book contract with Heinemann. They pay an advance of £ 50, with a 15 percent royalty. Heinemann will call it *The Time Machine."*

Jane summed it up. "We eat."

And it was time for me to get busy.

12. Epilogue

So I'm sitting here, writing *this* in the same open window, under the same green paraffin lamp, and probably under the scrutiny of the same nocturnal insects who watched me finish the final revision of *The Time Machine.** Which history of the Ma-

*Ed. Note: In August 1894 Wells, "Jane" (Catherine Robbins), and her mother departed from Charing Cross Station by train for Tusculum Villa, 23 Eardley Road, 7 Oaks, Kent, for a two week vacation. The vacation was overdue. Mrs. Robbins was ill and Wells was exhausted for reasons never adequately explained before the discovery of this document. He spent those two weeks rewriting *The Time Machine,* following Henley's suggestion to "cycle in on time to the end of the world." (In the prior rewrite Wells had stopped with the Traveler's escape from the Morlocks.) He wrote the last pages of the final revision at an open window at night, while down below the landlady loudly proclaimed the sinful morals of her new tenants to her neighbors. (Wells and Catherine were still unmarried.)

In June 1894 *The Time Machine* was published as a book in the form we know it today. Since 1888 it had been revised and/or rewritten six times and printed in various forms four times, with extensive revisions each time. As of its Centennial *The Time Machine* remains the most widely read of all Wells's novels. Probably only the Bible has been translated in more foreign languages.

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chine shall I send Henley? The one he already knows, of course. Who would believe the version where Albert and I changed the world?

[*Ed. Note: The following fragment was found in the papers of the Albert mss. How (or whether) Wells had intended to incorporate it is not clear.*]

The Year 1894

In this year Britain has a burst of creativity that could have come only from a nation with boundless optimism and a strong sense of honour. In this year Du Maurier came out with *Trilby;* Hope, *The Prisoner of Zenda;* Kipling, *The Jungle Book;* Shaw, *Arms and the Man;* Beardsley, drawings for Wilde's *Salome;* and Ramsay and Raleigh discovered argon. We owe at least some of this to the prince and his ideals of education and social justice.

I had not intended that this turn into a eulogy for the prince, and certainly not as a recommendation for the monarchy. I remain a staunch republican. Yet I cannot resist a temptation to compare the British achievement of 1894 with that of the French. His innocence notwithstanding, in this year 1894 to save the "honour" of the French army, Captain Dreyfus was sent to Devils Island. Could this have happened in Britain? Under the immortal eye of the prince? Never! ■

Nature is not benevolent; Nature is just, gives pound for pound, measure for measure, makes no exceptions, never tempers her decrees with mercy, or winks at any infringement of her laws.

John Burroughs

Censorship reflects a society's lack of confidence in itself.

Potter Stewart

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Brotherhood of the Stars, Kirby Greene, Bantam, $4.99, 230 pp. (ISBN: 0-553-29635-3).
Core, Paul Preuss, Morrow, $23, 350 pp. (ISBN: 0-668-09662-X).
The Magic Engineer, L. E. Modesitt, Jr., TOR, $23.95, 508 pp. (ISBN: 0-312-85570-2).
The Change, Barry B. Longyear, Pocket Books, $5.50, 309 pp. (ISBN: 0-671-73602-7).
Finder, Emma Bull, TOR, $21.95, 317 pp. (ISBN: 0-312-85418-8).
The Dubious Hills, Pamela Dean, TOR, $21.95, 316 pp. (ISBN: 0-312-85442-0).
Future Boston, David Alexander Smith, ed., TOR, $22.95, 384 pp. (ISBN: 0-312-85589-3).
A Tupolev Too Far, Brian Aldiss, St. Martin's, $18.95, 199 pp. (ISBN: 0-312-10565-7).
Books on Disk

Kirby Greene's **Brotherhood of the Stars** is a bleak but interesting tale. In a familiar distant future, humans are scattered among hundreds of other sentient species across the Galaxy, sharing worlds and ships and businesses. Ree Barsac is one such human who lives by crewing on starships. He's nothing exceptional—not captain, mate, navigator, just grunt labor—except in one respect: He once found an alien crewmate, a Luasparru named Zigmunn, with whom he felt instant rapport, and that feeling was reciprocated. He and Zigmunn were soul-mates, and in due time, when Zigmunn's homeworld elders approved, they were blood-brothers.

Sadly, Zigmunn developed a taste for strong drink, and a drunken brawl on Glaurus made him miss his ship. Barsac, bereft, did his best to find a gig that would bring him back that way, but it has taken him ten years to succeed. Now he cries, "Please, Captain, don't advertise that vacancy for a day or two. Give me a chance to find Zigmunn and offer him the berth. Then we'll be together again."

The captain magnanimously agrees to wait. But Barsac doesn't have long, and when he dives into the stews of the city, Zigmunn is nowhere to be found. A shopworn prostitute tells

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him, "Zigmunn? You're too late, deary. He's gone. Joined the Cult of the Witch just a few weeks ago. Now he's mindless, hidden behind those silver masks you see on the streets. Forget him, come to my room, I'll be nice . . . ."

Of course, Barsac can't forget. He flails about, is robbed, deceived, drugged, forced to miss his own ship, enslaved, driven to crime, drink, and degradation. Until he too is ready for the Cult. Initiation means a year on the nearby world of Azonda, where he soon learns that the Witch worshipped by the Cult is an ancient alien device that soaks up mind and will.

And Zigmunn is there. Now Barsac must resist the Witch's grip and rescue his friend. If he can.

Can he? Remember, I called this one bleak. It uses a quite conventional setting, and it gives that setting a very lived-in feel. There are color and grit, and almost a sense that you too have been there. But don't expect it to fulfill conventional expectations.

It's that old-time, super-science, sense of wonder, revival meeting time again. Paul Preuss is the presiding preacher, and if his sermon is a bit too contemporary to qualify (in some minds) as SF, it's still a thriller with a powerful scitech component.

The novel in question is **Core.** The gimmick is a collapse in the Earth's magnetic field, the necessary prequel to a statistically overdue reversal of the field. As field strength declines, its effects become apparent during times of increased solar activity, when more radiation penetrates the atmosphere and—especially at high altitude—people start dying of radiation poisoning. There doesn't seem much anyone can do except hunker down and pray.

Meet geophysicist Leiden Hudder. He's a bit unconventional, but very, very smart. Ditto his father Cyrus, who invented hudderite, a material harder than diamond and tough enough to withstand very high temperatures—such as those of the Earth's mantle and core—before he apparently leaped off the Golden Gate Bridge and died.

The trouble with hudderite is that it is very difficult to make in quantity. But Leiden gets wind of a scientist, Marta McDougal, who seems to be making progress on the problem. He meets with her; soon he has revived an old dream of drilling a hole all the way to the Earth's core. The potential payoffs include endless cheap energy and—just maybe—a way to straighten out the magnetic field problem. There is also an on-again, off-again love affair.

It is not long before we learn that Papa Cyrus did not die but was bought out by a mysterious outfit with a research camp in the Middle East. There he is pursuing the same dream as his son and Marta, confronting and solving the same problems, drilling a hole that slants off toward . . . . What? His bosses say there is a humongous bubble of gas down there. He believes them, until he finally gets an inkling of where the camp is and who his bosses really are.

The successes of the two groups do not come overnight. Leiden and

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Marta grow old in their decade-long quest. Cyrus grows older. In due time, both the plans of the good guys and the schemes of the bad guys ripen and converge. The book concludes with a rush of action that rounds everything out quite satisfactorily.

However, the book does have problems. The way Preuss chose to tell his story seemed scattered to me. The tale took an unusually long time to come together, though when it did it became very satisfying.

There are also a few unlikeliness factors. Hudderite would be nifty stuff, but it just isn't plausible, as Preuss recognizes in his afterword. Worse, I had trouble believing this story could possibly be happening right now, against a backdrop of current events including the Gulf War, with its culmination set for the mid-90s. But these are quibbles. Overall, *Core* is a fine effort, well worth the attention of anyone who craves a dose of high-tech adrenaline.

L. E. Modesitt, Jr., has a strong professional interest in environmental matters that has shown up in SF novels such as *The Ecologic Envoy* and *The Ecologic Secession*. It is thus not surprising to find the same thing in his fantasy work, the series that began with *The Magic of Recluce*.

I'm sorry I didn't read that one, for I have now read the third in the series, **The Magic Engineer,** and I found it quite enjoyably thought-provoking. The magic of Modesitt's world is of two sorts, order-based and chaos-based, and there is a balance such that the more order there is in the world, the more chaos there must be as well. One of the strongest forms of order is that of refined metal, especially iron, and even more especially when the iron is formed into machines such as steam engines. The chaos that necessarily accompanies the building and use of such devices includes air and water pollution.

That is, Modesitt's magic is a very thermodynamic thing. Chaos is entropy. Order is associated with those processes that decrease entropy, and it only happens if entropy increases elsewhere. (Modesitt does not point out that the net is always in entropy's favor; that is, chaos must win in the long run.)

The tale begins as Dorrin, the young son of a Black Wizard of Order, is banished from Recluce, the island stronghold of order. His sin is his fascination with the smithy and his dreams of building machines. Machines, you see, are something new, untraditional, unhallowed, and besides they run on the chaos of fire and steam, precisely the favorite tools of the White Wizards of Chaos, centered in Fairhaven on the mainland.

In due time, Dorrin settles down as a mainland smith. His two companions become warriors. The White Wizards plot to conquer Recluce. Dorrin begins to make machines, and the smell of Order he produces alerts the wizards. He must turn his skills to developing novel weapons for war even as he tries to repair the damage the wizards have done to his true love's mind and build his long-dreamt steam engine and steamship.

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All seems futile. He is only one man, after all, and even with his warrior friends, no matter how much damage they may do the wizards, he cannot stave them off. He must flee, back to Recluce, carrying his insights into the nature of magic, the balance of the world, and the necessary limits on technology.

If it weren't for those limits, I think, this fantasy would have appealed immensely to John W. Campbell, Jr. But Campbell was a strong believer in progress, even progress at any cost, and Modesitt is saying that it is possible to build too many engines, mines, factories, and so on. Relatively few are sufficient to meet the genuine needs of a society; more carry doom in their excess.

It was a bit of a surprise to learn that Barry B. Longyear was working on a pair of "Alien Nation" script-adaptation books. One would, after all, rather think of writers that good putting their time in on their own ideas, not those of others. But life has its pressures, and it really isn't that uncommon for writers—even well known ones—to rent sandbox space. So I said, "Show me." And he did. He also assured me that only the first novel was based on a script; the second *(Slag Like Me)* is an original.

"Alien Nation" was a TV show first, predicated on the idea that aliens, differing only in bald, spotted heads, double hearts, and pale blood, crashed on Earth and were immediately processed by the Immigration Service. Like other immigrants, the Tenctonese soon found niches among us. They became doctors and nurses, carpenters and chefs, actors and journalists, cops and robbers. The show focussed on that last, presenting itself as "part science fiction and part hard-hitting police drama —taking on tough social issues" (from jacket copy). Many people liked it—but not enough; the parable of racism was so heavy-handedly obvious that it is perhaps no wonder that the show was axed.

Barry's **The Change** began as a screenplay by Steven Long Mitchell and Craig W. Van Sickle. It opens at a maximum security prison, where alien bank robber Maanka Dak is adapting the Tenctonese mind-control technology for use on humans. He is smiled upon by authorities who believe he will help them cure mental illness and improve their control of certain groups. He is *that* close to parole and a life of well rewarded service to the human power structure. But he has his own agenda, one of vendetta against the cop who arrested him and killed his brother; in a Tenctonese tradition rooted in resistance to oppressors, he has vowed to destroy George Francisco *and all those who hold fond memories of him.*

And so the blood bath begins. Maanka Dak takes over the mind of the prison's warden, escapes, turns the warden into a homicidal maniac, and starts the stalk. He is a genius of foresight, a technological wizard. There is no stopping him.

Or is there? George Francisco is going through an alien menopause, riana, whose effects include a height-

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ening of intelligence. Alien elders are muttering zennish lessons about the flower and the weed. There is a message here about the power of labeling, and once it is understood, there is a way out.

On the way to that exit, the action is fast and furious, blood flows like water, suspense draws taut. As TV, this would have made a great show. As a novel, it's just what it sounds like—a page-turner of an adventure, a good read with a point.

And I'll let you know about *Slag Like Me*; judging from the first few chapters, it's even better.

The last time I mentioned Emma Bull, it was to praise her *Bone Dance*. Her new novel, **Finder**, displays much of the same talent and verve, though I thought it flawed by Bull's decision to set it in the too-generic "urban elves" sandbox. That aside, it's a cracking good read, a charming fantasy that is also an entertaining detective story.

The setting is the Borderlands, where Faerie overlaps with the mundane world. Elves and humans both walk the streets. There are strange hybrids. There is a strong attraction for misfits and wild talents from both sides of the Border. And there is Orient, a human blessed—or cursed, since it made him a pariah at home—with the ability to find things. Others need only ask, "Where is . . .?" and he can point to the lost object's location. He must also search it out, for his talent, once activated, is an itch that must be scratched.

The tale begins hard upon the death of one Bonnie Prince Charlie, a no-account runner of a strange drug reputed to turn humans into elves. Orient is recruited by Sunny Rico, a cop who reveals the drug's fatal truth and asks him to find its source. Unfortunately, Orient can only orient on something that truly exists, and therein lies the puzzle he must solve. Before he can ask his talent to find something, he must know what that something is. Along the way, he will nearly be killed. His best friend will die. The world he knows will change, and he will confront the past that drove him to the Borderlands, just as it drives so many misfits, in search of something like acceptance.

Too-common sandbox or not, the result it satisfying. It should even be satisfying for hard-SF fans, for much of the puzzle that drives the tale arises from the system underlying the fantasy.

Like Emma Bull, Pamela Dean is a member of the Minneapolis Fantasy Writers Group (the Scribblies), along with Steven Brust, Will Shetterly, and Patricia C. Wrede. The names alone are enough to tell you there is something special about the group. Their talents and their mutual encouragements, coachings, and eggings-on have provided fantasy fans with some remarkable fare.

Dean has written *Tam Lin* and the Hidden Country series. Here we have **The Dubious Hills,** which suffers from a rather dubious gimmick: Once upon a time, in order to eliminate war from human nature, wizards cast a spell whose effect was to eliminate

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knowledge as we know it. In that region known as the Dubious Hills, children are born with magic that permits them to do household chores; at the age of five or six, they lose it; at about the age of ten, they come into their Knowledge—they find that they Know the names of flowers, or how to make jam, or how to heal, to each his or her own and no one is superior to any other. Anything else is a matter of, "So and so says," and is therefore dubious.

Yet these kids attend school and learn what various so-and-sos have said. The people of the Dubious Hills therefore differ from others not in that they can't know more than others, but in that they have an innate specialty and in their tendency to doubt. The latter is the key point, and intriguingly it gives this fantasy a kinship to science. Yet though that may give Dean's creation some appeal to SF readers, it is not enough to make me feel that the tale can support its own logical weight. On the other hand, there are other kinds of weight....

The tale's viewpoint is that of Arry, an adolescent woman who Knows pain and can thereby tell the reader what other characters are feeling. (She also has to tell the other characters, for they cannot feel their own pain.) Her parents have vanished, leaving her with the care of her younger sister and brother. A friend, Oonan, is a Fixer who can repair the damage she can sense in others. He spends most of his time tending his sheep, and one day he reports wolves who do not act quite like wolves.

The alert reader immediately says, "Aha! Werewolves!" And so they are. But what are they doing? And why? And who are they when they wear human guise?

Along the way to answering these questions, Dean gives us some interesting characters and entertaining byplay. She also makes it clear that she is concerned with the nature of knowledge, the relative values of gut and head knowledge, and the value of pushing at the boundaries of knowledge.

In the end, Dean is even more satisfying than Bull—and I find it interesting that my initial, gut reaction was much the opposite; Dean—like knowledge—gains value with thought and reflection.

At the end of last year, I reviewed David Alexander Smith's *In the Cube: A Novel of Future Boston*. I thought it very interesting, a display of "impressive imagination and talent."

Now it's worth noting that that novel emerged from something called the "Future Boston Workshop," a group of Boston-area writers who meet regularly to kibitz each other's work. Such groups can be a great deal of fun; this one proves they can also be exceedingly productive. In 1987, they decided to work out the future history of a particular place—Boston, of course—and write stories to fit that history. That is, they conceived a new sort of shared-world anthology. The basic framework was simple: Boston sinking, the water rising, aliens arriving, the interplay of immigrants old and new, oppressive

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taxation by an external government, and eventually a new Revolution and a Free Boston. The details were more complex, the more so because if one member of the group added a character, alien, or event to the history, all other members had to take that as background for later stories.

The results include not only Smith's novel but also the anthology itself, **Future Boston: The History of a City 1990-2100**. The contributors include Smith, Alexander Jablokov, Sarah Smith, Geoffrey A. Landis, Jon Burrowes, Steven Popkes, and Resa Nelson, working singly and in various teams. Most are well known, successful SF writers, which perhaps goes a long way toward explaining why their joint product is so good. Indeed, the book actually achieves a bit of the feel of an anthology of historical documents—clippings, interviews, and so on—assembled to illuminate some long-past event. Add to that the excellence of the stories themselves—several are bound to show up on lists of award nominees—and one has to say the project was a resounding success.

Note that there is at least one more "Future Boston" novel coming your way: Jon Burrowes's *Vubre the Great*, which Smith calls a "wild novel . . . a cult classic in the making."

And now cross your fingers that the Workshop does not make the "Wild Cards" mistake of stretching their game out too long.

In the title story of Brian Aldiss's **A Tupolev Too Far**, an airliner from a world in which Russia is still ruled by the czars and glitters with high-tech wealth lands in our own Moscow, drab and lusterless. One might think two such different worlds to have nothing in common but the human dilemma. That is certainly there, and it provides the lecherous protagonist, a businessman of no great stature, with a little something to occupy his night. One might expect him to be facing a rather greater dilemma, for the political and business climates are so different—he has, after all, shifted worlds—but the people with whom he is supposed to negotiate a deal are there as well. Business proceeds without a hitch, and he is able to return home with signed contracts and a certain troublesome memento.

If you insist on logical consistency, this one will bother you. But Aldiss often digs deeply into the absurdist underpinnings of reality; here he may be saying that business and politics are irrelevant to what really matters, the true reality of the human soul. That's a thought that will appeal to many; I myself believe business and politics, science and religion are as deeply human as lust.

The games Aldiss plays are more "literary," if you will, more abstract, than many of us prefer. Yet even at his most abstract, he is a writer at whom to marvel. His style is polished, and his wit is legendary—who else, after all, would dare to tell us that when Jesus couldn't pay for his berth on Noah's boat, the captain handed him a broom and "Jesus swept."

Sometimes the wit is unsettling, as in "Summertime Was Nearly Over," in which a certain famous monster's

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wife is infertile for a very obvious—once we get the punch line—reason. Or the wit is downright bizarre, as in "Better Morphosis," whose narrator is a cockroach who wakes up one morn to discover he is Kafka. In two cases—"Confluence" and "Confluence Revisited"—the wit struck me as archly cute but hardly cute enough to justify the effort; those "stories" are nothing more than lists of alien terms with definitions (e.g., "LEONG M'BEE Congested bowels; an overpopulated city"; many are more cryptic).

Do you want the book? That depends on your taste for abstraction and arch wit, as well as how well you recall the stories from prior appearances. (I recognized some of the eleven stories and one poem as reprints, though there are no credit lines.)

BOOKS ON DISK

You'd think that by now the word would be out everywhere—at least everywhere this magazine goes. But no. The Good Doctor Schmidt recently received a letter from New Zealand's Ivan Millett describing his attempt at digital publishing with the line, "So far as I know books-on-disk (diskbacks?) have not been tried anywhere in the world before...."

OK. A good idea is a good idea, no matter how many times it gets rediscovered. So let's take a brief look at Millett's book, **Deus Ex Machina**, available for $6.95 (US, postage included) from TTTM, 10 Tennyson Avenue, Takapuna, Auckland 1309 New Zealand. He says that he has published it in this form because commercial publishers wouldn't touch it, but he also encloses a couple of positive reviews from Australia.

The book is a survey of a future interstellar civilization presented in the form of a series of "conversations" or lectures a bit less academic in tone that W. Warren Wagar's *A Short History of the Future* (University of Chicago Press, 1990). There is a large amount of arbitrary and off-putting jargon, and the intent is to consider important philosophical issues (such as free will), sometimes satirically, but Millett leaps among so many issues that his impact is seriously diluted. He also displays a considerable debt to such previous works as Jack Williamson's *The Humanoids*.

Millett clearly put a great deal of thought into this, but he seems to have produced neither a novel nor a finished work of philosophical satire but rather a background study for the novel he has yet to write. When he writes that novel, it could be quite as interesting as anything by Iain Banks. ■

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Cyn Mason & Dave Meyer

A (MERCIFULLY) BRIEF EXPLANATION OF NANOTECHNOLOGY

Just what is nanotechnology, anyhow? A term to fire the imagination, to thrill the questing spirit of research, to open the near-infinite realms of possibilities and generate countless grant proposals.

So what, exactly, is it? Hey, let's get small! When we dissect the word itself, we get 14 letters, 5 of which are vowels, and one "y" which can substitute for a vowel. This makes the vowel/consonant ratio variable between 5/9 (55.55555555555—ad infinitum, ad nauseum—percent) and 6/8 (75%, a nice sensible percentage that doesn't want to make trouble). As you can see, the difference is highly significant, even though y is only one fourteenth (7.14285714285—yes, another troublemaker that repeats endlessly! percent). This clear proof demonstrates that a single tiny change can make a big difference, which is what nanotechnology is all about; the science of mucking about with extremely small things, such as atoms and molecules and congressional ethics.

To extend this intellectual exercise further, let us look at the roots of the term as well; "nano," an alien greeting used in a '70s sitcom, and "technology," the excuse offered by telephone companies for consistently overbilling you. (It's *never* the fault of a human being.) When these are combined, we get a greeting from an erroneous extraterrestrial billing. It was probably caused by a microchip. Or Robin Williams.

The microchip was one of the first very small machines. If you take an itsy-bitsy wafer of very pure silicon (the sort used as the Host by religious robots) and deliberately pollute even smaller parts of it (preferably with a solution of tequila combined with any citrus juice, as long as it's fresh-squeezed), this will alter the path of electricity flowing through it. Electricity likes to have a good time, and it will therefore follow the path of least resistance straight through the tequila, rather like a touring science fiction author with an expense account.

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ience progresses, we are learn-
build smaller and smaller func-
units, much like the evolution
e studio apartment or the vice
sidency. Microchips these days are
tremely small, but they're still on
olecular levels. Descending by an order of magnitude, let's examine atoms. Since atoms are very difficult to take apart, we'll just have to go and smash some. Don't knock it, this attitude has gotten science pretty damn far.

If atoms are so small, why does it take such a big machine to smash them? Atoms are very hard, so the atoms that hit them to break them must have lots of room to build up speed. Let's check out just how this occurs.

A machine for smashing atoms is called a cyclotron; from "cyclo," a word abbreviating the scientific phrase "killer packs of radioactive lawless atoms cruising around on incredibly small Harley-Davidsons looking for trouble" and "tron," which was a really terrible movie. It's built like a big round bowling alley the cyclos can cruise around in, gaining speed. Inside, an endless film loop shows the movie over and over again on the walls of the circular corridor. Scientists release a pack of cyclos into the alley and the first thing they see is *Tron.* Repulsed, they increase their speed, going faster and faster, accelerating furiously in a futile attempt to find something less boring. Suddenly they meet another atom, told by the scientists to "stay right there and you'll get a surprise." Wham! Cyclos bash right into the little sucker, crashing into it so hard they combine into a dangerous, unstable new element (rather like Ross Perot's presidential non-campaign) which promptly breaks down (the analogy becomes obvious here).

These are only a few of the previous developments toward nanotechnology. There are even more possibilities to come. Eventually, we'll have tiny injectable robots to do remarkable things, such as clean out hardened arteries, using incredibly small Hoover vacuums; or repair damaged brain cells, such as the handful possessed by our local TV news anchor. Imagine this: tiny molecule-sized robots, kinda like "Rosie" on *The Jetsons,* scrubbing out your arteries and cheerfully wisecracking with equally tiny mechanic-type fellows, wearing very small coveralls and carrying minuscule tool chests.

Or another possibility—tiny hitmen, armed with itsy-bitsy AK-47s, wiping out viruses. This unfortunately opens up an entire realm of possible ills, such as some of the tiny robots going renegade, starting up protection rackets and similar criminal activities right inside your very veins. Attorneys will explain, "My client had no choice, your honor, crime is in his blood." (An argument right up there with "my client was temporarily insane when he stabbed the victim 47 times. . . .") After due consideration, all that's going into these authors' bloodstreams in the near future is some of that tequila. ■

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BRASS TACKS

Dear Dr. Schmidt:

Several years ago, I attended an SF convention in Baltimore. The woman sitting next to me wore a button claiming that "socialized medicine was brought by the same people who run the Post Office." I asked why, if the US medical system is so great, SF conventions regularly hold auctions to pay the medical expenses of members of the SF community. The 1987 Balticon held an auction to help artist Frank Kelly Freas pay the medical expenses incurred by his wife during her final illness.

Flash forward to Kevin J. Anderson's story "Tide Pools" in the December '93 *Analog*. Anderson's gesture in giving his payment to the fund for George Alec Effinger's medical expenses was a noble one—but the US is the only industrialized country where a citizen can be "uninsurable."

I know all the arguments put forth by American groups on why a Canadian-style system won't work in the US. Sadly, most of the arguments are better directed against the US system. You have the world's most expensive health care system, which still leaves large segments of your population without coverage.

One good reason was provided by the testimony of a Canadian offi before a Congressional committ He pointed out that in Canada, a ministrative expenses take 11¢ of e ery health dollar. In the US, the figur is 23¢. That's nearly $100 billio worth of inefficiency right there.

I've heard all the stories about people who have suffered by falling through the cracks of the Canadian system. So show me the system, public or private, that is perfect.

Better still, count the number of Americans who have lost their homes, savings, or even their lives because they lost their medical coverage, or because their private insurer went bankrupt, or because, like George Alec Effinger, they were simply "uninsurable." I think the Canadian system will win.

Your medical insurance lobby reminds me of the joke about the mother watching the soldiers march off to war. "They're all out of step except my son," declared the proud mother.

JOSEPH ASPLER

CANADA

P.S. In the letters section of the same issue, Brett Bellmore of Capac, MI analyzes the thinking behind your 2nd constitutional amendment on gun control. Mr. Bellmore seems to

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[redacted] the existence of

[redacted] of nearly 3 million [redacted]t 70 murders per [redacted]ities of comparable [redacted] or 700 murders per [redacted] that you have a prob- [redacted]utions are made to [redacted] the times. That's the dif- [redacted]ween a Constitution and [redacted] Writ of your choice.

[redacted]. Schmidt:

[redacted]e Pools" (12/93) has a charac- [redacted]th a demyelinating disease. Ac- [redacted]ing to the author, this disease [redacted] eventually involve "the nerves [redacted]at controlled breathing and heart- [redacted]eat," and the character "would one day find himself without a heartbeat, then fall over and die." Though not impossible, this is very unlikely to occur. The autonomic nervous system does regulate certain cardiac functions. However, the heart can work reasonably well independent of it, and could continue to beat at a rate and strength adequate to keep the character alive even if those parts of the nervous system were destroyed. Patients with cardiac transplants have, in fact, had the nerve connections to the heart disrupted, yet life-threatening arrhythmias are uncommon. Even assuming the character at risk, readily available technological solutions (e.g. an implantable pacemaker to treat a dangerously slow heart rate) are available.

Unlike the heart, however, the lungs do not have an intrinsic "back-up" system. Damage to the parts of the nervous system that control breathing could, as the author describes, easily result in the character dying in his sleep. Technological "solutions" to this problem, such as electrophrenic stimulation or use of negative- or positive-pressure ventilators are, for a variety of reasons, less than ideal.

"EMT" (same issue) also deals with a medical problem—performance of emergency care (including cardiopulmonary resuscitation, or CPR) on the Moon. In this story, a victim is placed in a pressurized glass tube fitted with gloves protruding inward to allow rescuers to provide care. Although the author notes that it is necessary to "ensure the breathing" of the victim, providing any but the most rudimentary respiratory support (i.e. placing an oxygen mask on someone who was still breathing, or opening the airway in someone who was not) would be difficult in this coffin-like arrangement. The "respirator mask" used later in the story would probably be at best a marginally successful, very short-term "solution" due to difficulty with maintaining a face-to-mask seal, lack of protection of the airway, etc. Alternative methods, such as placement of an endotracheal tube or esophageal obturator airway, would also be difficult to implement.

Other "eyebrow raisers" in this story included some deviations from the current protocols for CPR (perhaps they've changed by the time of the story?), and occurrence of ventricular fibrillation in the setting of hypovolemic shock due to bleeding (possible but not likely unless the

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victim had other problems too, such as hypothermia).

These minor technicalities aside, I thought both stories were very enjoyable and well-written. From my perspective as a cardiologist and an instructor in Basic and Advanced Cardiac Life Support, I commend both authors for their efforts and skill in dealing with these complex medical problems.

HENRY STRATMANN, M.D.
4903 Southridge Park Drive
St. Louis, MO 63129-1795

Dear Dr. Schmidt:

Dr. Gillett mistakenly identifies magnetohydrodynamics (MHD) as a thermal process, subject to the limitations of the Carnot cycle in the article "Beyond Prometheus" (*Analog*, December 1993). This is not the case.

To quote Dr. Francis Chen[1]: "Magnetohydrodynamic (MHD) energy conversion utilizes a dense plasma jet propelled across a magnetic field to generate electricity. The Lorentz force *qv* x B, where v is the jet velocity, causes the ions to drift upward and the electrons downward, charging the two electrodes to different potentials. Electrical current can then be drawn from the electrodes *without the inefficiency of a heat cycle.*" (Emphasis mine)

It is a shame that an article aimed at encouraging us to think of nonthermal solutions for engineering problems would mis-identify MHD in this manner.

MICHAEL F. STEMPER

[1]*Introduction to Plasma Physics*, Chen, Francis F., Plenum Publishing Corporation, 1974.

The author replies...

Dear Stan:

The analysis of MHD in the
is correct; the increased effici
possible are merely due to the h
temperature of the working
Chen's assertion, which Mr. Sten
quotes, is simply wrong. Perh
Chen was the victim of bad editi
but this underscores that offhand
sertions, even in technical referenc
are not always correct. The energ
in a plasma is thermalized, and th
Second Law places a fundamental
limit on the amount of that energy that could be converted into useful work, irrespective of the mechanism of such conversion. That limit is not Carnot limit, and it depends only on the difference in temperature between the source and sink. This shows the strength of thermodynamic analysis: fundamental constraints on a system can be established using only the values of the appropriate state functions; the exact mechanism is irrelevant. (By the same token, though, thermodynamics says nothing whatsoever about *what* mechanisms could approach the limiting values.)

STEVE GILLETT

Dear Mr. Schmidt,

I would like to comment on the illustrations Broeck Steadman did for "Young Again," by Jeffery D. Kooistra, in your December 1993 issue.

They are well done, but the people in them are completely different than the characters illustrated in the first story (May 1993 issue) done by Dell

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vision of "Sun- of December the same hair ." of pages 14-15 I realize each artist nt "visions" of the where it is a continu- fer some continuity.

article ncies igher fluid. iper aps ng, as- s, y

comment, Mr. Stead- ation on pages 12-13 of ber issue shows a lot of ied "round" dials. Even military, that great bastion conservatism, is getting way his type of instrumentation. even beginning to fund retro- g older aircraft with "glass" kpits, similar to other new wide- dy commercial jets. The cockpit il- strated by Mr. Steadman looks like the cockpit in the KC-135, a Boeing 707 type aircraft, my Guard unit flies, a 1950s design.

And my pilot friends would want me to mention that the left side of the cockpit, where Professor Dykstra is sitting in the illustration, is traditionally where the aircraft commander sits. If the professor is in the "copilot" seat, the window should be over his right shoulder.

Notwithstanding my comments on the illustrations, I enjoyed the story very much. In fact, all of the stories in this issue made great reading. I especially liked "The Ears Have It." I laughed out loud when I got to the last line.

JOHN FORBES

5387 Leprechaun Lane
SLC, UT 84118-7002

Thanks for your letter. I, too, usually prefer continuity of illustration in the stories of a series, but occasionally strange and convoluted circumstances keep us from getting it. In this case, the same circumstances also contributed to the "Fiftyish" cockpit—though I suppose it's conceivable that this far in the future there could be a fad for "antique" control panels. And there's certainly no reason to assume the crew would be arranged the same way.

Thanks for writing: I'm always very interested in readers' comments.

Dear Stan:

I figured out what Bud Sparhawk was up to as soon as he introduced the DSHR and DNCR vessels in "R-TRNRD" (in *Analog*'s Christmas issue). From then on, it was easy to follow his thought trends and decode the other secret messages—right up to the last paragraph. There I got stuck! Please ask Mr. Sparhawk to translate sjkdnf for us, if it has any translation, or else put us out of our misery by telling us so, if it has none.

PETER J LUSBY

The author replies....

I am so embarrassed that such an obvious typographical error should have evaded both my own review and that of the many crack editors at *Analog*. "Sjkdnf" is so obviously wrong that it should have stood out like a bright shiny nose. I didn't mean "sjkdnf" for that obviously doesn't make any sense whatsoever in the context of R-TRNRD's confusion following the crash. The phrase should have been "-sncls? Mrr . . . exms . . . n-hppi. Nu yrs *sjknfz*."

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I hope this clears up this matter.

BUD SPARHAWK

P.S. The original form *can* be translated as "It's a joke, done fin . . . ." Alternate interpretations are welcomed, the more obscene the better. Glad you enjoyed this one.

Dear Mr. Schmidt,

I'm writing to you for some help in searching out an old SF story. I'm a pretty good researcher and I've hunted the libraries and "old book" stores to no avail. I'd really appreciate some assistance.

A few decades ago I read a story, as I remember it, entitled *The Age of Consent*. A search of that title, or anything like it, brings up romance novels or short stories about a young girl's first sexual encounter.

The story I am searching for was a brilliantly written SF novel about a time in the near future when society, suffering from excessive crime, consented to 100% video monitoring of all activities, private and public, as long as there were no human monitors, just computers. It came out about the same time as Orwell's *1984*.

I've re-read *1984* and I'm quite sure that a lot of the concepts that have been credited to Orwell were actually in *Consent*. The mix-up isn't Orwell's fault. It's just that commentators and critics must have read both works in the '50s, then when *1984* became popular in the '60s they wrote comments from memory. *1984* really isn't that good of a treatise on the concept of absolute control of society. It's primarily about the use of propaganda to keep people's thought's in line.

In *Consent* the video netw
telligent computer system u
huge database along with patter
ognition of each individual and
social habits.

The system utilized random s
ning by video cameras in private
public locations to keep track of
eryone. A security force respon
would be triggered when someor
did something considered to const
tute anti-social behavior that migh
lead to crime.

The bad guys were computer programmers who gradually changed the "anti-social behavior" trigger decision to include anyone that didn't follow the dictates of the dominate political party.

The hero was one of the programmers with a conscience who quietly rebelled and, knowing the limits of the recognition algorithms, became a non-person (that the computer could not identify), then taught others to do the same.

In today's climate of fear of—crime, disease and environmental catastrophe—a number of groups are offering increased safety and security in exchange for the loss of individual freedom. We already have national databases that can track every citizen that we can identify. There are movements afoot to make sure we can identify everyone, everywhere, all of the time.

The *Age of Consent* is upon us and I'd like to see if that story is all that I remember it to be.

I'd appreciate your help! Perhaps you personally know what it is and

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f'm enclosing a
: *Analog* readers

in your thoughts,
.e Reader's, on this
.pt.

RICHARD JEPPERSON

I don't recognize THE NSENT, and I haven't been d it in any of the sources I I may be able to get your let- Brass Tacks, but I can't prom- , so I suggest you continue to ier approaches. Have you tried ibrary of Congress?

ar Stanley,

I just finished parent-teacher's con- erences for my eighth and sixth grade sons. Between the two recommended reading lists for them, there was one science fiction book—*A Wrinkle in Time*. No Heinlein, Asimov, Clarke, or anyone else. Just the one. At home they can read *Tom Swift*, both new and the old, as well as those listed above, and others. I know that many of them are suitable for their age groups. I was reading Asimov, Heinlein's juveniles, E.E. "Doc" Smith, and Saberhagen's Berserker stories by their age. My sixth grader is now reading through the "Death Gate Cycle."

Here's a challenge to the SFWA, or to *Analog's* readers Make out a science fiction suggested reading list for all grade levels. It shouldn't be too difficult. At what age should the average child tackle the Foundation Series? At what age can rishathra be safely discussed in class? (If AIDS prevention can be taught in kindergarten, it shouldn't be too advanced a concept at any age thereafter. Or should it?) Are there any science fiction books suitable for first graders? Is there an already established author willing to tackle the task of writing for the really juvenile market? Cracking that market would be a real challenge. Could a Caldecott or Newbery Medal be awarded for a story that also receives a Hugo or Nebula? Would it be worth attempting?

More than any other form of literature, science fiction sparks the imagination. Additionally, a lot of it teaches, without preaching. It seems to me that the SFWA would have a vested interest in producing and distributing a recommended science fiction reading list. Every time I have mentioned adding more science fiction material to a reading list, the teacher has shrugged his (or her) shoulders, and changed the subject. Being armed with an already published suggested reading list from a professional writer's group would be a big help. ■

HAROLD W. HAMBLET

Brunswick, ME

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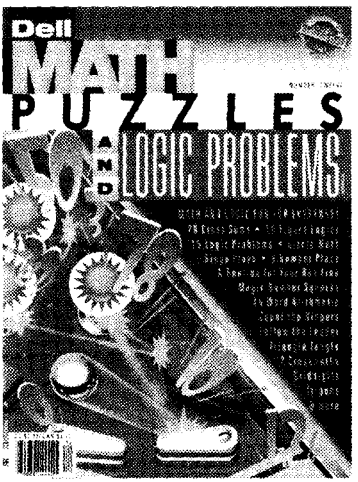

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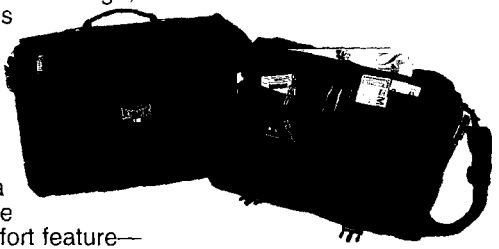

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